THE FOUNDRY

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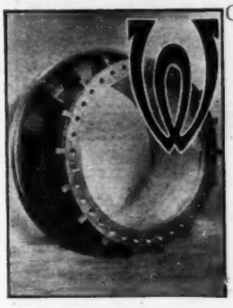
Molding and Casting Large Bronze Valve Parts

How the Exeter Machine Works Solved the Problem of Making These Sections, Both in Foundry and Machine Shop



WORK is now nearing completion at the plant of the Exeter Machine Works, Pittston, Pa., on one of the largest contracts for bronze castings that has ever been executed in this country. The heaviest castings that have been made weigh 19,700 pounds in the rough, or nearly 10 tons, and since the work was started over 1,000,000 pounds of bronze have been melted and poured into molds. The contract, which was let by the board of water supply of the city of New York, calls for six 72-inch bronze riser valves and 25 48-inch valves, weighing altogether over 375 tons. These valves form a part of the new Catskill water supply system for the city of New York. They are of the plug type, of a special design which will be described later. There were so many difficulties surrounding the construction of the valves that although the contract involved payments aggregating approximately $300,000, there were only four bidders.

Problems Solved

The problems that have been solved both in the foundry and machine shop in executing this work have presented many interesting features and the foundry work, owing to the great weight of the castings and the large amounts of bronze melted, has been particularly unusual. The bronze has been melted entirely in crucibles in furnaces provided with special equipment for handling the molten metal rapidly. The melting loss has been less than 3 per cent, owing largely to the care taken in the operation of the furnaces. Most of the castings have been made in dry sand molds in solid flasks, except the shells for the 72-inch valves, which were molded in loam.

The Catskill water supply system is an enormous project involving an expenditure of over $175,000,000. An aqueduct capable of delivering 500,000,000 gallons of water daily has been constructed between the Ashokan reservoir in the Catskill mountains and New York City, a distance of 127 miles. The aqueduct proper terminates at the Hill View reservoir, a short distance southeast of Yonkers, N. Y. From this point the Catskill water will be delivered to the five boroughs constituting the city of New York by a circular tunnel which extends under the full length of Manhattan Island and continues across the East river through Brooklyn and under the Narrows to Staten Island. This tunnel has been driven in solid rock, its diameter ranging from 15 to 11 feet. Under the Narrows, the water will be carried in a special ball-and-socket joint, cast iron pipe which is being made by the Westinghouse Machine Co., Pittsburgh, Pa. The water will be conveyed from the tunnel under the city to the surface mains in the streets through a series of vertical shafts, ranging from 218 to 752 feet in depth. The flow of water through the shafts will be controlled by the large bronze plug valves that are being made by the Exeter Machine Works. These valves are made entirely of manganese bronze, because it will be very

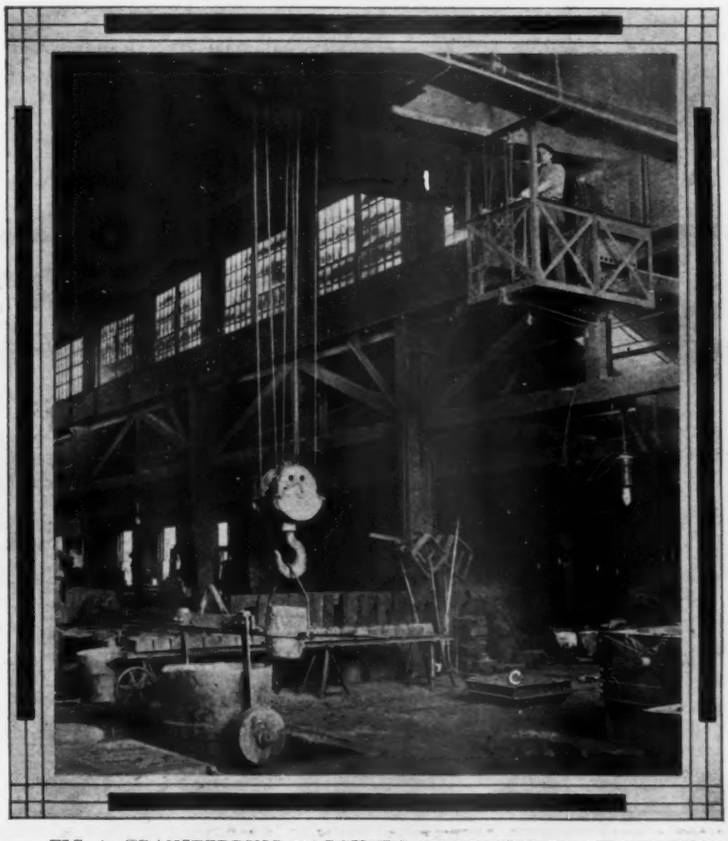


FIG. 1—TRANSFERRING 500-POUNDS OF BRONZE TO THE CRANE LADLE

FIG. 2—GENERAL VIEW OF BRONZE MELTING FURNACES

difficult to repair them after they are once placed in service. They are designed for an operating life of 1,000 years.

A cross-section of one of the 72-inch valves is shown in Fig. 4. As indicated by this illustration, it consists of a large bronze shell into which a spider carrying a piston, 3 feet, 9 inches in diameter, is secured. A cylinder to which the valve plug is bolted slides over the piston. The movement of the plug is steadied by a tail rod which slides in a heavy bronze tripod. The entire valve, which is located at the bottom of the shaft several hundred feet below the surface, is encased in concrete.

There are three 1-inch holes in the cylinder casing through which water is admitted into the cylinder. The piston cover also is provided with three 1-inch holes which allow the water to flow out above the piston as the valve closes. With the valve in its normal position, the water pressures are approximately balanced on both sides of the piston and the valve remains open by its own weight. If, however, an abnormally high flow occurs past the valve, the operating mechanism opens a pipe which connects the interior of the cylinder with the atmosphere. The resulting difference in pressure causes the valve to close. The holes for the entrance and egress of water are so proportioned that a closing period of 2½ minutes is provided under ordinary conditions, resulting in a water hammer of 35 pounds to the square inch. Even under abnormal conditions, the design is such that the water hammer cannot exceed 70 pounds per square inch. When it is desired to close the valve by hand for any reason, it is only necessary to allow the water to escape through the outlet pipe,

FIG. 3—MAIN BAY OF EXETER FOUNDRY SHOWING LARGE BRONZE MOLDS READY FOR POURING

thus reducing the pressure in the cylinder. This is accomplished by pulling a rod which works the operating mechanism.

To give some idea of the large amount of foundry work involved in making these valves, the rough and finished weights of the principal parts of the 48-inch and 72-inch valves are given in Table I.

Melt Both Bronze and Gray Iron

The foundry of the Exeter Machine Works is equipped for melting both gray iron and bronze. The building is 250 feet long and 110 feet wide. It is of the usual monitor type with a center bay 50 feet wide and two side bays each 30 feet in width. The main bay is served by two Niles traveling cranes having lifting capacities of 10 and 25 tons, respectively. The iron melting equipment includes two cupolas, one 42 inches and the other 48 inches in diameter; the bronze is melted in a large crucible furnace. The shop is provided with three mold drying ovens, the largest being 20 feet square and 12 feet high. The plant also has the customary equipment for making and drying cores of various sizes including both shelf and car ovens. The cleaning room equipment is modern and adequate. The traveling crane runway extends out over the flask yard east of the foundry building.

The specifications for the bronze valve castings are very rigid and each of the valves is subjected to severe tests before shipment. The work of casting and machining the valve parts is constantly supervised by a resident inspector representing the board of water supply and in order to fulfill the contract successfully, it was necessary that every casting be practically flawless. A special paragraph in the specifications states that patched or plugged castings will not be accepted.

Test bars or coupons are molded with every casting and are required to undergo a rigid physical examination. The minimum allowable tensile strength is 65,000 pounds per square inch, with the yield point at 32,000 pounds per square inch and an elongation in 2 inches of at least 25 per cent. The specifications also require that all of the bronze shall be alloyed with manganese or vanadium. It is further stated that all of the bronze castings shall be made of new metal, free from objectionable imperfections. Metal which shows signs of imperfect mixing on machining is rejected.

To produce castings which would measure up to the requirements of these rigid specifications, the Exeter Machine Works has installed a crucible melting furnace of special design. Although the weight of the metal involved was exceptionally large, it was decided at the outset that suitable, uniform results could not be obtained except by melting in crucibles in comparatively small quantities at a time.

The bronze melting furnace, Fig. 2, burns anthracite coal under natural draft, the stack being 30 inches in diameter and 110 feet in height. The fire holes are arranged in a single row and the entire construction of the furnace is simple and economical. Each melting unit is separated from its neighbors and consists simply of

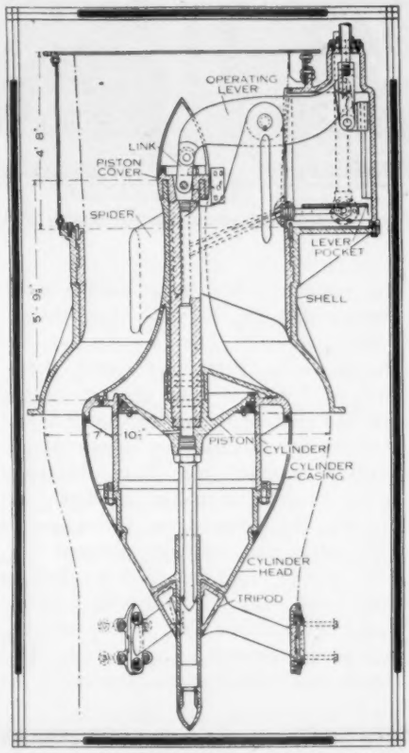


FIG. 4—SECTION OF 72-INCH RISER VALVE

a cast iron frame supporting a circular grate and a brick lined fire pot. A subway is provided under the floor in front of the grates for the removal of ashes. The furnace is sufficiently large to heat 41 crucibles at one time.

Crucibles holding about 545 pounds of molten metal are used. The new crucibles are stored behind the furnace over the main flue, as shown in Fig. 2, where they undergo a seasoning process before being used. About 18 heats are obtained from each crucible before it is discarded.

A special arrangement for transferring the melted bronze from the crucibles to the large crane ladle has been devised and is illustrated in Figs. 1 and 9. A small floor-operated, one-ton traveling crane furnished by the Sprague Electric Works, New York City, serves the entire battery of fire holes. The pots are drawn from the fire by this crane and are conveyed to a small transfer car, *C*, Fig. 9, which carries them to the crane ladle situated in a pit under the main traveling crane runway. The span of the Sprague crane over the furnace is 12 feet and its runway is 200 feet long. It operates at a good speed and the metal is handled much more rapidly than would be the case by hand, or with the ordinary hand-operated chain hoist.

When pouring a large mold, the metal from a sufficient number of crucibles is first accumulated in the crane ladle by means of the Sprague hoist and transfer car system described. To pour a 72-inch valve shell, 21,000 pounds of bronze are drawn from 41 pots and transferred to the main crane ladle in about 37 minutes. Eight minutes more are required to pour the metal into the mold, the whole operation occupying about three-quarters of an hour.

The Bronze is Carefully Mixed

The Exeter Machine Works do not use prepared ingots, but mix their own manganese bronze. The bronze from which all the riser valve castings were made contains six elements including copper, zinc, iron, tin, manganese and aluminum. In melting this mixture, it is the practice to make preliminary alloys of certain groups of metals, such as tin, iron and manganese, which are combined with the copper in the final melting. By means of this preliminary alloying, the difficulties resulting from the great differences in the melting points of the various constituents of the bronze are overcome, the subsidiary alloys having such proportions that their melting points are reasonably close together. In the final mixture, the copper is first melted in the crucible, after which the tin, iron, manganese and aluminum, suitably alloyed, are put in, followed by the zinc. Some additional tin is added just before removing the pots from the fire.

Table II gives the constituents of the bronze mixture as it is prepared for the crucible, together with a typical analysis of borings from a finished casting.

In the casting, it will be noted, the relative proportions of copper, zinc and iron are less than in the original mixture, due to melting losses. Slight increases in the percentages of tin, manganese and aluminum are shown by analysis. A small quantity of lead which existed in the original mixture as an impurity appears in the analysis of the casting. From two to three hours are required to melt a

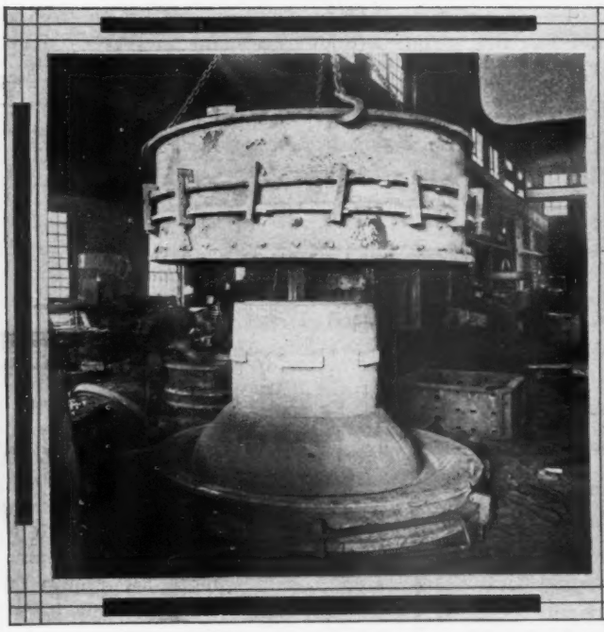


FIG. 5—REPLACING THE CHEEK ON A 48-INCH VALVE SHELL MOLD

FIG. 6—POURING 8,700 POUNDS OF BRONZE IN A 48-INCH VALVE SHELL MOLD

500-pound bronze charge. Except that the metal is thickly covered with charcoal, no great efforts are made during melting to avoid oxidation, but, as previously stated, the pouring operations are conducted as rapidly as possible to prevent deterioration in the quality of the bronze. The aluminum is added to the bronze because it aids in the production of a smooth, finished casting.

The pattern for a 48-inch valve shell is shown in Fig. 7. This shell is similar in form to the 72-inch shell, except that the bell of the latter is provided with 26 stiffening ribs. In the rough, the casting weighs 8,700 pounds and the finished shell weighs 4,900 pounds. The weight of the shrink heads, gates and risers, therefore, is 77½ per cent of that of the finished casting. This excess of metal is necessary to insure a dense, homogeneous product, free from shrinkage spots or objectionable cavities. In making the pattern, a shrinkage of 3/16 inch per foot is allowed for. The pattern for the 48-inch shell is over 3 feet high. It is 6 feet, 7 inches in diameter at the base and 4 feet, 1¼ inches in diameter at the top. The metal has an average thickness of 1½ inches. The casting is molded in a three-part, circular cast iron flask, the drag being 10 inches, the cheek 36 inches and the cope 10 inches in depth. The diameter of the flask is approximately 8 feet. The drag contains nothing except the lower flange of the shell. In making the mold, the drag is first set on the floor on a bottom board and filled with sand, after which the pattern is properly bedded in place. The cheek then is set in position and the pattern, which is hollow is filled with sand and rammed both inside and out. The cope, which contains

FIG. 7—THE PATTERN IS MADE IN TWO PARTS

FIG. 8—BRONZE RISER VALVE SHELL CASTING WITH GATES AND SHRINK HEAD ATTACHED

nothing but a print for the large, annular shrink head, is set in place and rammed up after the sand in the cheek has been struck off.

When the ramming is finished, the cope is lifted off the cheek by the crane, exposing the pattern. The latter is divided in the cheek, as shown at *D*, Fig. 7. The top part is drawn out of the sand first, after which the cheek is lifted bodily off of the pattern by the traveling crane. The lower half of the cheek pattern then is pulled off the green sand core, leaving the mold in the condition shown in Fig. 5.

The various parts of the mold are dried over night in a large, coal-fired oven. The mold, as shown by the rough casting, Fig. 8, is fed through two square runners, which terminate in ordinary gates connected with the lower flange of the casting in the drag. The cross-section of each runner is four square inches. The gates are set tangentially to the flange, so that the metal is given a whirling motion as it enters the mold.

The large shrink head shown at the top of the casting in Fig. 8 is approximately 4 feet in outside diameter, 5 inches thick and 10 inches high. While the metal is solidifying, it is carefully fed from the shrink head. Two days are required to ram up the mold for a 48-inch shell, one molder and a helper being employed on the job. The 72-inch shells are swept in loam.

Table I

ROUGH AND FINISHED WEIGHTS OF 48 AND 72-INCH VALVES

	Weight of rough casting with gates, risers and shrink heads attached, pounds.	Weight of finished casting, pounds.
72-inch shell	19,700	11,000
72 inch spider	15,200	8,700
72-inch cylinder	9,800	4,300
72-inch cylinder head.	5,500	2,500
72-inch piston cover..	3,300	2,500
72-inch piston	3,000	1,800
72-inch cylinder casing	2,750	2,000
72-inch lever pocket..	3,100	2,300
72-inch tripod	2,200	1,300
48-inch shell	8,700	4,900
48-inch spider	5,500	2,700
48-inch cylinder	4,400	.....
48-inch cylinder head.	3,100	.....
48-inch piston cover..	2,000	1,000
48-inch piston	1,250	.....
48-inch cylinder casing	1,900	1,000
48-inch lever pocket...	2,600	1,600
48-inch tripod	850	500

The other large bronze castings necessary for the construction of the 48-inch and 72-inch riser valves also are molded in dry sand and are handled in a manner similar to the methods previously described.

FIG. 9—THE CRUCIBLES ARE PULLED FROM THE FIRE WITH A CRANE AND DEPOSITED ON A TRANSFER CAR

In addition to its large bronze melting facilities, the foundry of the Exeter Machine Works is equipped to make large quantities of gray iron castings. At present about 26,000 pounds of gray iron are melted daily. This work presents no unusual features. The smaller dry sand cores are molded on a bench in the core department which is situated opposite the cupolas. The barrels containing core blacking are provided with compressed air jets for stirring the mixture. The large dry sand cores are molded on the floor along with the molds for the gray iron and bronze castings.

Pattern Shop

The plant of the Exeter Machine Works also includes a thoroughly equipped pattern shop located in a separate building, 90 feet long and 40 feet wide. It is situated adjacent to the foundry. This shop is equipped with the usual array of wood turning lathes, planers, jointers, circular saws, band saws, etc.

When the bronze castings for the riser valves are ready to leave the foundry they are transferred on an industrial railway to the machine shop where the necessary machine tool operations are performed and the valves assembled. The machine shop is 75 feet wide and 350 feet in length. It is thoroughly equipped with modern tools. Before each valve is shipped it is assembled in the machine shop and subjected to a rigid inspection to develop flaws in workmanship and material. These inspections are supervised by a representative of the board of water supply of the city of New York. Among other things, the specifications provide that a hydrostatic test pressure of 600 pounds per square inch shall be applied to the interior of the cylinder and maintained for 30 minutes, during which time the castings shall be water-tight. In order to pass this test, it is of course necessary that extreme care be used in the foundry in melting, mixing and handling the bronze to avoid any spongy spots in the castings.

The New York water supply valve contract has been executed under the general supervision of J. N. Thomas, president of the Exeter Machine Works, assisted by A. L. LeGrand, manager. The work of making the castings was under the direction of C. E. Schley, foundry superintendent.

Detroit Foundrymen's Association

At the annual meeting and banquet of the Detroit Foundrymen's Association held at the Cadillac hotel, Detroit, Thursday evening, May 14, officers for the ensuing year were elected, as follows: President, A. F. S. Blackwood, Michigan Steel Casting Co.; vice-president, Robert Carolin, Robert Carolin Brass Co.; secretary, Wm. A. Fletcher, American Blower Co., and treasurer, N. I. Chase, Cadillac Motor Car Co., Detroit.

Table II

BRONZE MIXTURE USED

	Bronze mixture as prepared for crucible, per cent.	Analysis of resulting casting, per cent.
Copper	56.00	55.80
Zinc	41.25	40.61
Iron	1.25	1.22
Tin	1.00	1.62
Manganese	0.25	0.45
Aluminum	0.25	0.27
Lead	0.00	0.03

Members of the executive board: H. W. Johnson, Fairview Foundry Co.; J. A. Moore, American Blower Co.; Edw. Bierwith, Russell Wheel & Foundry Co., and J. W. Collins, Aluminum Castings Co.

E. J. Woodison was toastmaster, and several novel entertainment features were introduced. The reports of the secretary and treasurer showed this organization to be in a prosperous condition, and the percentage of attendance during the last year was greater than that of any previous year in the history of this society.

The Sand Blast From Viewpoint of the User*

Pertinent Pointers for Foundrymen Regarding the Use of This Cleaning Device and Suggestions for the Selection of the Proper Machine

By H D Gates

THE constantly extending use of the sand blast beyond its parent field, the foundry, indicates its advantages, realized frequently even under the most adverse conditions. While we are for the moment concerned only in its adaptability to foundry practice, still some knowledge of its various accomplishments give us a better conception of its wide usefulness. The manufacturing foundrymen and the machine shop owner know that a thoroughly sand-blasted casting not only works faster in their machines, giving an increased output, but materially reduces tool expense and lowers production cost. The sheet and structural workers have begun to appreciate its advantages, and the railroads are today practically unanimous in demanding the sand-blasting of steel cars before painting, which not only gives a better surface for the paint to adhere to, with a correspondingly better finished job, but prevents corrosion which is vastly more important. Bridge builders are taking the same view, and the government demanded that the gates of the Gatun locks of the Panama canal be sand blasted before painting, and is also cleaning the hulls of its ships, preparatory to painting and re-painting, with the sand blast. Makers of automobile bodies in steel and aluminum are surfacing them before painting. Forge shops are removing the scale to save their dies and to prevent the chipping of the metal under the dies. Metals to be plated, jappaned, galvanized or sherardized are thoroughly cleaned preparatory to treatment, and many other varied lines of work are treated, down to small jewelry, which is given a satin finish, all by various types and methods of sand blasting.

Varied Uses

Glass has long been frosted, lettered and decorated by the sand blast, and inquiry has been made for a machine to clean eggs, presumably after they had accumulated dirt and grime through long storage. Abrasives, paving materials, rubber and other products are tested for quality by sand blast methods. We are all familiar with the cleaning of stone, brick and concrete buildings, and as it is used for roughing the handles of instruments to assure the surgeon a firm hold, for the surfacing of metal caskets and the lettering of grave stones, the sand blast may be said to be with us from the beginning to the end.

The advantages to the foundryman and to the sand blast manufacturer, while viewed from different angles, must in both cases come from the same result—satisfactory operation for the purpose of profit. The sand blast machine or installation which does not in its results amply warrant the investment, is to the foundryman but an annoyance and expense, and to the manufacturer a black eye as a reference for future sales. With these conditions so apparent, the closest and most sincere co-operation between buyer and seller should be preliminary to any installation that is to prove of benefit to both.

Points to be Considered

To determine the type and size of the sand blast machine we must first consider the material to be cleaned. What will be the average shape, size and weight of the pieces and the daily volume? Is it generally plain-surfaced, or intricate cored work? What is the range of weights from minimum to maximum? Is it stock work that runs very much alike at all times, or is it the general jobbing run that may vary largely from day to day? What percentage of the work will be small, that is most quickly and cheaply cleaned in the sand blast barrel? What percentage is too large for barrel work? Is any portion of it of such size and shape that economy would be found in cleaning it on a revolving or traveling table machine? Is it such a conglomeration of various sizes, weights and shapes that there is not enough of any particular kind to warrant the installation of either of these automatic machines, so that we must revert to the old stand-by, the hose type machine that will clean anything and everything? No intelligent consideration can be given the subject without this knowledge and of the volume and pressure of air available.

If all other consideration than the character and volume of work could be eliminated, our selection of a type of machine would be reasonably simple, but as the sand blast is in every instance dependent on compressed air for its operation, this item must of course be considered in conjunction with the machine. Has the foundryman already compressed air installed, and if so, what volume of free air per minute can he give for sand blast uses? And to what pressure does he initially compress his air? If we are limited in this way and compelled to meet conditions that cannot obtain the lowest cost per ton of cleaning, the why and the wherefore should be thoroughly gone into, to determine whether a sufficient advantage in added economy can be definitely shown to warrant an investment in additional air equipment.

Assuming, however, for the moment that the volume of the different classes of work are sufficient to warrant an automatic machine with its economy of handling and that the air volume available is sufficient for its operation, we have a selection of two types before us.

For small work adapted by size and shape to cleaning in the sand blast barrel, there can be no question of the economy of this type of machine. The air volume required will of course be governed by the number and size of the nozzles and actual comparison of cleaning time with different size nozzles is the only way to determine the most economical for various classes of work. A single nozzle in larger size, of right design, construction and location, giving correct application of the sand stream to the work will be found more economical in air consumption and power cost than multiple nozzles of smaller sizes.

Round Table Machine

Pieces too large for successful barreling, but that still permit of automatic handling will be cleaned with least labor, on the round and reciprocating table machine. If, however, the pieces are of such shape or design as to demand constant labor in turning them to bring all surfaces under the action of the nozzle, the question of economy under these conditions requires the closest consideration before selecting this type of machine for varied work, although on certain classes of material, it is ideal.

In machines of automatic operation, construction showing fewest parts and

*Presented at the April meeting of the Associated Foundry Foremen of New York.

simple design with correspondingly least wear and fewest repairs, will mean longest life and should have careful attention beyond the mere cleaning results obtained. It is safe to say, however, that owing to the varied character and limited output of the majority of foundries, the investment warranted for sand blast equipments, demands a machine that will clean anything and everything, even though with a loss of economy on some portion of the output, and to meet this nothing yet has been presented to equal the hose type machine.

Machine Must Stand Hard Service

The machine being designed to clean castings and displace sand, some of which has fused and become almost as hard as the metal itself, it is evident that to be efficient, in addition to being available for any pressure, it must resist the hardest service to be found in the foundry. Here, particularly, does the question of simplicity, few working parts giving a minimum of upkeep cost and with corresponding ease of operation become paramount. To maintain a steady, constant flow of sand and assure the use of the entire machine load, a cone bottom of the right angle is necessary. Graceful lines maintained at the expense of false bottoms which can hardly be made sand tight, but provide a hiding place for dead sand, are of little value.

Double tanks, internal mechanism, supplementary values and other construction which adds parts, and does not increase efficiency, should be avoided. A simple sand valve to close air tight with an air valve which brings the air in direct line to the opening of the hose, all in a single piece and easily removed, promise best service, maximum efficiency and longest life with least trouble. A dished head fitted with a screen will assure quick filling with the elimination of funnels, pails and troublesome gaskets, caps and bails.

The size of the hose type machine itself should, unlike the self-contained, continuous feed automatic machines, be selected with reference to the nozzle equipment to be used. As an illustration: Under 10 pounds pressure a 3/16 inch nozzle flows 48 cubic feet of free air per minute and discharges approximately 500 pounds of sand per hour. A ¼ in nozzle flows 85 cubic feet of air and discharges approximately 900 pounds of sand per hour. A 5/16 inch nozzle flows 133 cubic feet of air with approximately 1,300 pounds of sand per hour discharge. A ⅜ inch nozzle passes 191 cubic feet of air with approximately 1,700 pounds of sand per hour. In a ½ inch nozzle, 340 cubic feet of air with approximately 3,000 pounds of sand per hour are discharged.

As economy will be obtained through the constant operation of the sand blast machine, it will be apparent that in frequent refilling of the sand tank, if done by other than automatic means, will be desirable and it would hardly be advisable to select a machine that would give less than an hour constant operation and a sand storage capacity doubling this would pay in the end if the machine is to be hand-filled.

With the type and size of the equipment determined, we are up to the question of air volume and pressure requirements. If the plant is without air, compressor equipment must be installed. Now, don't make the mistake of buying a compressor of sufficient size to barely meet immediate needs. Fully 90 per cent of the foundries today are complaining of lack of compressed air volume, and this is due to the constant added demands which are made on the air plant, once it is in operation. The greater first cost of an air compressor of large volume over the same type of small capacity is so comparatively slight, that the provision of ample air to permit use of proper equipment for cleaning at the lowest cost per ton, is undoubtedly found advisable in the long run.

Particularly is this so, as the cost of compression per cubic foot of free air to a given pressure is no greater with a large capacity machine than with the small, and the larger machine, to meet present needs, can be run at reduced speed to produce a lesser volume, with a corresponding reduction in horsepower. It is then available for increased demands when wanted, while it is not safe to run the small machine at a speed beyond its rated capacity. In any type of

CUBIC FEET OF FREE AIR PER MINUTE FLOWING THROUGH DIFFERENT SIZE NOZZLES AT VARIOUS PRESSURES WITH HORSEPOWER DEVELOPED IN SINGLE STAGE COMPRESSION AT SEA LEVEL WITH USUAL LOSSES.

Figures For Air Are Printed in Black Face Type

Pressure at gage in pounds per square inch.

Nozzle diam., in.	20	30	40	50	60	70	80	90	100
	7.70	**10.00**	**12.30**	**14.50**	**16.80**	**19.00**	**21.20**	**23.50**	**25.73**
1/8	0.63	1.03	1.50	1.99	2.57	3.19	3.86	4.51	5.53
	12.04	**15.72**	**19.17**	**22.68**	**26.22**	**29.71**	**32.20**	**36.44**	**42.50**
5/32	0.99	1.62	2.34	3.11	4.01	4.99	6.04	7.00	8.80
	17.10	**22.50**	**27.50**	**32.80**	**37.50**	**43.00**	**47.50**	**52.50**	**57.88**
3/16	1.40	2.32	3.26	4.49	5.74	7.22	8.65	10.08	11.98
	23.77	**30.81**	**37.58**	**44.44**	**51.37**	**58.24**	**65.08**	**71.43**	**78.80**
7/32	1.95	3.17	4.58	6.09	7.86	9.78	11.84	13.71	16.31
	30.80	**40.00**	**49.10**	**58.20**	**67.00**	**76.00**	**85.00**	**94.00**	**103.00**
1/4	2.53	4.12	5.99	7.97	10.25	12.77	15.47	18.05	21.32
	39.02	**50.94**	**62.13**	**73.47**	**85.00**	**96.00**	**108.00**	**118.00**	**130.00**
9/32	3.20	5.25	7.58	10.07	13.00	16.13	19.66	22.66	26.91
	48.17	**62.89**	**76.70**	**90.70**	**105.00**	**119.00**	**133.00**	**146.00**	**161.00**
5/16	3.95	6.48	9.36	12.43	16.07	20.00	24.10	28.03	33.32
	58.29	**75.10**	**92.81**	**109.85**	**127.00**	**144.00**	**161.00**	**176.00**	**195.00**
11/32	4.78	7.74	11.32	15.05	19.43	24.19	29.30	33.79	40.57
	69.00	**90.00**	**110.00**	**130.00**	**151.00**	**171.00**	**191.00**	**211.00**	**232.00**
3/8	5.66	9.27	13.42	17.81	23.10	28.73	34.76	40.51	47.90
	81.00	**106.00**	**130.00**	**153.00**	**178.00**	**201.00**	**225.00**	**246.00**	**272.00**
13/32	6.64	10.92	15.86	20.96	27.23	33.77	40.95	47.23	56.30
	94.00	**123.00**	**150.00**	**178.00**	**206.00**	**233.00**	**260.00**	**286.00**	**315.00**
7/16	7.71	12.67	18.30	24.39	31.52	39.14	47.32	54.91	65.21
	108.00	**142.00**	**173.00**	**204.00**	**236.00**	**268.00**	**299.00**	**328.00**	**362.00**
15/32	8.86	14.63	21.11	27.95	36.11	45.02	54.42	62.98	74.93
	123.00	**161.00**	**196.00**	**232.00**	**268.00**	**304.00**	**340.00**	**376.00**	**412.00**
1/2	10.09	16.58	23.91	31.78	41.00	51.07	61.88	72.19	85.28
	156.00	**204.00**	**249.00**	**294.00**	**340.00**	**385.00**	**430.00**	**472.00**	**521.00**
9/16	12.79	21.01	30.38	40.28	52.02	64.68	78.26	90.52	107.85
	193.00	**252.00**	**307.00**	**364.00**	**420.00**	**476.00**	**532.00**	**587.00**	**643.00**
5/8	15.83	25.96	37.45	49.87	64.26	79.97	96.82	112.70	133.10
	233.00	**304.00**	**371.00**	**439.00**	**508.00**	**575.00**	**643.00**	**706.00**	**778.00**
11/16	19.11	31.31	45.26	60.14	77.72	96.60	117.03	135.55	161.05
	277.00	**362.00**	**442.00**	**522.00**	**604.00**	**685.00**	**765.00**	**843.00**	**925.00**
3/4	22.91	37.29	51.48	71.51	92.41	115.08	139.23	161.86	191.48
	378.00	**493.00**	**601.00**	**710.00**	**822.00**	**930.00**	**1,004.00**	**1,145.00**	**1,261.00**
7/8	31.00	50.78	73.32	97.27	125.77	146.56	182.73	219.64	261.03
	494.00	**645.00**	**785.00**	**930.00**	**1,070.00**	**1,275.00**	**1,360.00**	**1,500.00**	**1,647.00**
1	40.51	66.44	95.77	127.41	163.71	204.12	257.52	288.00	340.93

sand blast machine, the air requirement which governs the power consumption will be determined by the size and number of nozzles used and the pressure maintained.

The accompanying table shows the air consumption through various size nozzles at different pressures with the horsepower developed, assuming single stage compression with allowance for the usual losses at sea level, and gives at a glance some conception of the increase in air flow as the nozzle size is increased.

What Pressure is Best?

Undoubtedly the satisfactory working pressure is the most mooted question among sand blast manufacturers today, but there is one answer to this question on which all agree, and this is the pressure which will do the work the cheapest, all other conditions to be met considered. To determine what this pressure is, we will have to come back to our first consideration of the material to be cleaned. Is it gray iron, malleable annealed or unanealed, steel, or is it brass, bronze or aluminum? How thoroughly does the producer or customer demand it to be cleaned? What degree of care has it had in molding? How tenaciously does the sand stick, or to what extent it is fused with the casting? What is to be the ultimate use of the finished piece?

If it is required merely to remove the loose sand, a working pressure under 30 pounds will undoubtedly be satisfactory even on iron or steel, and would provide a surface suitable for painting. If, however, the casting is to be machined, every particle of the fused sand should be taken off, to expose the pure metal to the action of a cutting tool. On steel pressure up to 90 pounds is desirable for the most economical cleaning.

Exposure of the pure metal will not only materially reduce tool expense, but in actual practice has demonstrated that an increased output of 15 per cent is possible in the machine shop, and this is an item that should not be overlooked by the manufacturing foundrymen or the jobbing foundrymen supplying castings to be machined. Pieces that are to be galvanized, sherardized, plated, japanned or enameled, must also be thoroughly freed from the fused sand and scale.

To determine the most economical pressure there must be taken into consideration beside elements of labor and abrasive, the initial pressure to which the air is being delivered from the compressor. Most pneumatic equipment used in the foundry today, requires 80 pounds pressure and in most instances therefore, we find air being delivered to the receiver at this pressure. While it might be demonstrated that the castings could be most economically cleaned at a lower pressure if the air was initially compressed to this point by reason of the lesser horsepower required, if other requirements in the plant demand a standard pressure of 80 pounds, sight must not be lost of the fact that every foot of air used for sand blast purposes which is reduced to the lower pressure is costing the same in horsepower as though it was used at the initial pressure of 80 pounds. While, too, it is true that the volume of air at lower pressure would be less than at 80 pounds, calculation must be made on the basis of cost of initial pressure to determine which, under these conditions will be the cheaper, other factors entering into the cleaning being considered as well.

Double Compressor Systems Undesirable

There are few foundries other than those handling the largest output that will consider a double air plant system, one at higher pressure for other pneumatic equipment and low pressure for the sand blast operation, even with some constant saving in power cost. Unfortunately, accurate cleaning costs which should embrace compressed air power cost, labor, abrasive consumed, ventilating power cost, interest on investment and depreciation, as well as the saving to be effected in the grinding and chipping department and the machine shop, are not kept in many foundries or at least this has been the experience of the writer, and in considering this question of economical pressure, we therefore, are compelled to rely on personal observation as opportunity offers and on theoretical tests which do not always approximate operating conditions.

There can be no successful contradiction that on non-ferrous metals with other conditions right, the lower pressure up to say 40 pounds will be found economical, as well as in certain classes of iron work, notably bath tub and other sanitary wear castings. Keeping in mind that in every instance the thoroughness of the cleaning must be a determining factor, efficiency of the various pressures can be determined by the results obtained under like conditions.

In the tests made by Professor Wm. T. Magruder, covered in a paper read before the American Society of Mechanical Engineers, his results in removing metal from a cast bar, shows that the time required to remove one pound of iron at 20 pounds pressure was 3.55 hours; at 30 pounds, 2.77 hours; at 40 pounds, 2.13 hours; at 50 pounds, 1.52 hours; at 60 pounds, 1.07 hours, and at 70 pounds, .82 hours.

The approximate correctness of these results are corroborated by general observation of various lines of work over a period of some years, and in one or two instances where extended tests under working conditions have been made. In one instance, on steel, with compressors carefully calibrated, it was shown that at 40 pounds pressure through a 9/16 inch nozzle, 230 cubic feet of free air per minute requiring 73 horsepower to develop, cleaned 120 pieces, weighing 200 pounds each in a 10-hour day.

With pressure at 80 pounds passing through a ½ inch nozzle flowing 140 cubic feet of free air per minute, 156 pieces were cleaned in 10 hours. In the first instance the air was compressed to 80 pounds, and passed through a reducing valve to the sand blast machine. Under these conditions the power saving, operating with the higher pressure, was enormous when considered annually. Had the air in the first instance been initially compressed to 40 pounds, the power saving would have been over 12 per cent at the higher pressure, to say nothing of the greater output.

The general proposition of the low pressure cleaning is volume of sand, which requires large hose and nozzle, consuming air at low pressure and cost, while the high pressure operation provides minimum of sand driven at highest velocity through small hose and small nozzle with high pressure and cost of air.

As a general conclusion, we agree with Prof. McGruder's contentions that the horsepower cost for the same results by either operation with the air initially compressed to the operating pressure is approximately the same, and that the determining factors, therefore, will be the volume of output with the minimum of labor.

Use of Proper Sand

The abrasive to be used should be well considered in any sand blast installation. Here again we are hampered in reaching a definite conclusion through lack of accurate results in actual practice.

Thorough separation of dust and abrasive must be assumed in the use of either for best efficiency, and the methods to obtain this adapted to the abrasive.

With the increasing use of sand blast equipment, it is becoming recognized that comfortable conditions for the sand blast operator with adequate ventilation, far from being philanthropic, are but a sound business policy, and hardly any consideration of sand blasting would be complete without touching the various systems to accomplish these ends.

Sand blast rooms range from the simple enclosure with a solid floor from

which the used sand can be shoveled for re-use, and ventilated with a wall fan, drawing the dust out of the room into the surrounding atmosphere, to systems which prevent the rising of the dust to the operator's head. The conditions which will determine for the employer to what extent he will provide these devices, should begin with the cost per ton of cleaning, to determine the investment warranted. Method of confining the dust and the degree to which this must be obtained will be governed by demands of geographical location to residence districts, other plants and machine shops, which would be annoyed by the created dust, and this question alone will cut some considerable figure in the cost of installation. Methods of handling and screening the sand, should be determined not only by the cost of power requirements, but by the efficiency of separation demanded, and the kind of abrasive used.

Some idea may be obtained of the relative value of these installations from the fact that one steel concern by the installation of a plant providing adequate ventilation with the abrasive handled, screened and cleaned automatically, was able to increase the output of its sand blast from 15 tons in 10 hours to upwards of 18 tons in five hours, or over four-fold.

Routing of the material and handling methods are other items that should not be overlooked. The experience of two concerns having identical equipment will be illuminating on the value of this item; one obtained an output of 35 tons per day, while the other complained of the inefficiency of equipment because they were turning out but 10 tons per day. This condition was corrected through the co-operation of the manufacturer to secure proper handling, and is but an instance of the value he can be and should be to the user to their mutual advantage.

If you are operating a machine shop and install a lathe costing $300 or $400, you see that the tool has proper care and is not used by other than an experienced capable lathe hand. The chances are, however, that your sand blast is turned over to the cheapest and most ignorant laborer in your plant, with no intelligent supervision, and still you wonder why you don't get satisfactory returns. A sand blast manufacturer received a complaint from one of his customers that his machine would not work, and a request that a representative immediately be sent to locate the trouble. The proprietor was not at the plant when the representative arrived, and he immediately went into the sand blast room, looked over conditions and then returned to the office to await the owner's arrival. When the proprietor came in he said, "Let's go down and see what the trouble is. I have not been down there in three months." With his first step into the sand blast room, he stooped down and picked up a handful of sand from the floor, and said, "What do they mean by using this sand?" He located his own trouble before he looked at the machine, and had not taken this precaution before writing the manufacturer to send someone to straighten it out. A burned fine core sand was being used, which was largely dust, and this, with the condensation of the moisture in the compressed air, had formed a mud and caked an air inlet, a trouble that so far as the operation of the machine was concerned, was corrected in less than 5 minutes. When conditions were brought to this man's attention, he was keen enough to see that, not only had the present trouble resulted, but that he had been constantly getting far from the efficiency he was entitled to, through his own negligence and the use of imperfect material.

Development of Match-Plate Molding

By Lloyd S Cooney

MATCH-PLATE molding is of comparatively recent origin and before the introduction of this device all molds were made with loose patterns. Models of small parts usually were placed in numbers on a follow-board, and after ramming, they had to be drawn laboriously and frequently were printed-back by hand, thus making the work both slow and tedious. Occasionally a number of small pieces were gated together so that by holding the sprue pin they all could be lifted at one time. However, as the gates usually were made of brass or other soft, workable metal, they often were bent so that the pieces would not lie flat on the follow-board, or the patterns themselves would become loose on the gates, causing a ragged lift that required considerable time and labor in slicking the mold to produce clean castings.

Subsequently, the idea of making a mold from the master pattern for small bench work was developed.

LOOSE PATTERN AND MATCH-PLATE METHOD OF MOLDING CONTRASTED. AT THE LEFT IS SHOWN A MOLDER DRAWING A LOOSE PATTERN AND AT THE RIGHT A MATCH-PLATE IS EMPLOYED. THIS REFLECTS THE EASE WITH WHICH THE PATTERN IS DRAWN FROM THE MOLD BY THIS PROCESS

The plate was made by separating the cope and drag of the mold approximately 5/16 inch, and after blocking the edges, the mold was poured, thereby producing a plate 5/16 inch thick with the face of the pattern on one side and the back on the reverse side. This plate was used as a pattern and after ramming the mold the plate was withdrawn, the mold containing the imprint of the pattern only. As the gates were cast on the plate, no cutting of the sand was necessary with the exception of placing the sprue or sprues when molding. As these plates largely were made of cast iron, their weight was excessive and their usefulness on floor work was limited. Aluminum, therefore, was substituted for cast iron in match-plate work and a bench plate of cast iron that weighs 27 pounds can be reproduced in aluminum at a weight of 11 pounds.

Plates for floor work, however, did not meet with immediate success. Trouble was experienced with the pins and hinges, the larger plates having been rolled instead of lifted. Shifts were so common that many foundrymen became discouraged and several types of long hinges that would accommodate also the plate lugs and spring pins were introduced. Several types of hinges, however, are now employed and are being used successfully, and the writer is using a type which consists of two separate pairs of hinges, one for the flask and one for the plate. In addition, one rigid pin is used in common by both plate and flask and all trouble has been practically eliminated. The printing of the pattern also is made comparatively easy by a match-plate fitted in this way.

Despite the obvious advantages derived from the use of match-plates, there are numerous disadvantages, inasmuch as the pattern must be uniform and correct as to thickness and true as to alignment, owing to the fact that the castings will be an exact duplicate of the pattern. With a loose pattern the molder can correct any difference in thickness by forcing the pattern deeper into the drag with a small mallet, but this cannot be done with a plate which rests solidly on the edges of the flask. The only variation possible is due to a soft mold or by forcing the iron. Great care also must be exercised to prevent sand or other foreign substances from becoming lodged on the edges of the flask before ramming, otherwise, when the plate is removed and the flask is closed, if these obstructions should have been brushed off, the mold will be squeezed and the resulting casting will be too thin.

In some cases paper has been pasted on the match-plate around the pattern to cut down the thickness of the castings. However, this is contrary to good foundry practice and should not be tolerated. The pattern either should be run according to size and if a thinner casting is desired, the pattern should be cut down or a new one made. The ideal method of molding stove plate is by the use of match-plates correctly designed and properly manipulated.

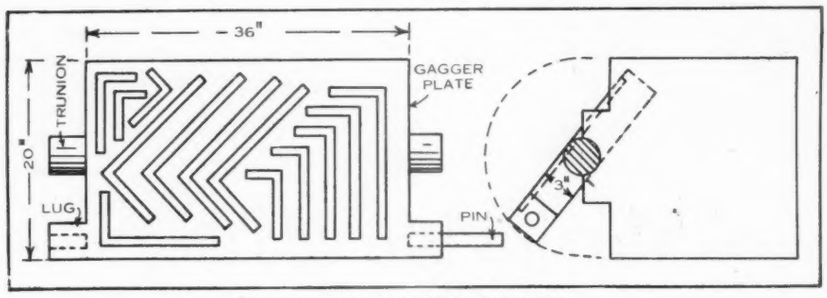


PLATE FOR MAKING GAGGERS

In the foundry with which the writer is connected match-plates are molded in a flask about 4 inches larger in inside dimensions than the plate to be made. No. 00 Albany stove plate sand is mixed with molasses and water and the mold is rammed fairly hard. The patterns then are drawn, the gates to be used when making castings from the plate are cut and the face of the mold is dried with a torch. Strips of 1½ x 5/16 inch wrought iron are laid along the sides and ends of the mold. The end strips are placed the same distance apart as the length of the finished plate, but the side strips are about 4 inches further apart than the width of the plate to accommodate the flat sprues with which the plate is run. Perforations are cast along the edge of the finished plate to facilitate cutting-off the strips containing the sprues. The mold then is closed on these strips, the edges are banked to prevent a run-out and the mold is ready to be poured. The match-plates are made from a mixture consisting of 12 per cent copper and 88 per cent aluminum. The copper is first melted, after which the aluminum is added and care is exercised to keep the aluminum from attaining a bright red heat. Zinc chloride is used as a flux to purify the metal and the slag is blown off with bellows. The composition is poured as cool as it will run.

Cutting Gagger Costs

By N. Liscomb

A simple and inexpensive device for rapidly producing various size gaggers is illustrated herewith. The apparatus consists of only three parts, a cast iron plate, in which the various gagger prints are cut, and two cast iron rests. The plate is about 36 inches long, 20 inches wide and 3 inches thick, with 3-inch trunnions and lugs cast on each end. Molten iron is poured over this plate with one sweeping movement. The gagger prints are of various sizes as desired and are made with liberal draft to enable the newly-made gaggers being readily jolted out. The gaggers cool rapidly and may be removed in a few seconds. In order to remove the gaggers the plate is simply turned over with a pin inserted in one of the lugs, the movement terminating with a jolt of the lugs against the rests or standards.

Slow Cupola Melting

By W. J. Keep

Question:—Two inquiries were received from different manufacturers relating to their cupola practice, the first stating that it was his belief that 1 hour and 40 minutes is too long a time for taking off a heat of 7,500 pounds of iron and he asked whether his practice was satisfactory. The furnace shell is 42 inches in diameter and is lined to 34 inches. The six tuyeres are 14 inches from the cupola bottom and are 9 x 3⅛ inches in size. The blast is delivered to the cupola through two pipes. The bed charge consists of 400 pounds of coke and 2,000 pounds of iron, after which 100 pounds of coke and 100 pounds of iron are charged successively. The mixture consists of 500 pounds of Virginia iron, 100 pounds of Lake Superior iron, 100 pounds of steel scrap and 300 pounds of cast scrap.

The second manufacturer states that his cupola is lined to 26 inches and that he melts about 10,000 pounds of iron daily in from 2½ to 3 hours. The cupola is equipped with upper and lower tuyeres, the upper ones

having been closed while the lower tuyeres are 18 inches from the bottom plate. The blast pressure is 7 ounces. This manufacturer would like to know whether it would be advisable to mix anthracite coal with the coke after the fifth charge. The iron charge on the bed weighs 1,200 pounds and the remaining charges are 1,000 pounds each.

Answer:—Replying to the first inquiry, the rated capacity of the cupola with a 42-inch shell is 5,000 to 6,000 pounds per hour, or approximately 7,600 to 10,000 pounds in 1 hour and 40 minutes. All of the proportions are correct. The melting ratio is nearly 8 to 1 and this is very good for a furnace of this size. The cupola probably is equipped with an upper row of tuyeres, and it is advisable to close them with brick and

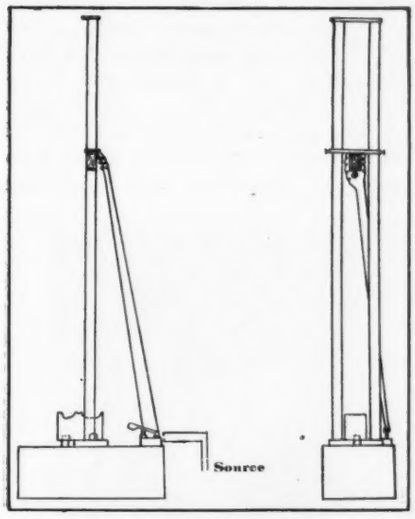


FIG. 1—DROP TESTING MACHINE FOR GOGGLES

clay. Light the cupola two hours before the iron is required and have the coke 15 to 18 inches above the lower tuyeres before beginning to charge iron. For further information regarding the method of measuring coke, see page 162 of the April, 1914, issue of THE FOUNDRY. The melting speed will depend on the speed with which you burn the coke, which in turn depends on the amount of blast. Increase the blast and the speed of melting will increase. The pigs should be broken in two pieces and the scrap also should be broken small and should be charged carefully so as to leave no openings.

In reply to the second question, the manufacturer failed to state the weight of the coke charges and it likewise will be advisable for him to read the article on page 162 of the April issue of THE FOUNDRY. The directions given in that article will apply in his case. One thousand pounds of iron is too large a charge for a 26-inch cupola. Try 600-pound charges and 60 pounds of coke. Further, 10,000 pounds is too large a melt for a 26-inch cupola, unless the heat is slagged. Draw the slag as soon as it will run. Add 20 pounds of limestone on each charge of coke to make fluid slag. It is advisable to use coke on all of the charges, including the bed. A fuel with sulphur below 0.08 per cent should be employed. With so many charges it might be advisable to employ the second row of tuyeres until the iron is nearly all melted and then to close them with a valve provided for this purpose. However, better results might be obtained with the upper tuyeres shut off entirely.

Specifications for Chippers' Goggles

The Illinois Steel Co., Chicago, has prepared a set of specifications for chippers' goggles and has designed a machine for testing the strength of the lenses. In order to form a proper protection for the wearer, the glass in goggles must have a certain degree of strength and elasticity and the lens must be so designed that no glass will fly from the inside surface in cases of breakage. This is important because it readily can be appreciated that splinters of glass would be as injurious to the eyes of the workmen as any other flying material.

The strength of the lens is tested by dropping a small steel ball on it from a predetermined height. The drop test machine is illustrated in Fig. 1, while Fig. 2 shows a top and side view of the white pine goggle support. The latter is designed to hold the goggles under test in such a manner that the frame is given a proper bearing on rubber and cotton composition strips, without permitting the lens itself to rest on the support or to receive any backing other than that naturally given by its own frame.

The height of the drop is 21 inches from the bottom of the ball to the surface of the goggle lens. The ball is made of steel and hardened. It is ⅝ inch in diameter and weighs approximately 16 grams. The ball is released so that it falls freely without any initial momentum. Fifteen consecutive blows are given on the center of the lens, on the surface which is exposed to flying matter. On each shipment of a gross or less of goggles one dozen must be tested, and of this dozen, 25 per cent, or three pairs, must stand 15 blows without breaking or cracking. This means that the six lenses of the three pairs of goggles in the test dozen must be intact after the 15 blows. If less than 25 per cent stand the test, the entire gross is rejected.

If in the test dozen of goggles, any goggles break under the drop in such a way that glass flys from the inside surface of the lens, meaning the surface that is next to the eyes of the man wearing the goggles, then the entire gross will be rejected, even if three pairs of goggles have successfully withstood 15 blows each under the drop test.

The specifications require that the thickness of each lens shall be measured at four quarter points on a circle whose radius is equal to two-thirds the total radius of the lens. An extreme variation of 0.0005 meter is allowed in the thickness of the lens between any two points. An extreme variation in thickness between two lenses in the same pair of goggles of 0.001 meter is permitted.

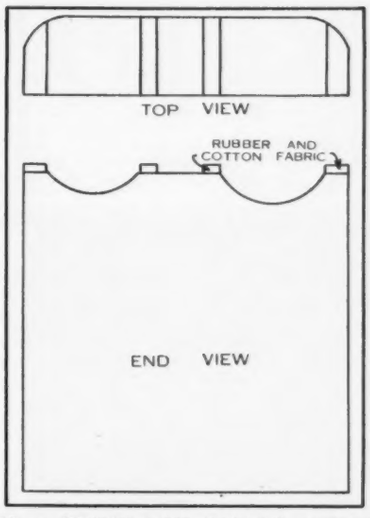


FIG. 2—WHITE PINE GOGGLE SUPPORT

According to the Illinois Steel Co.'s specifications, the cost of the dozen goggles used for the test is divided equally between the manufacturer and the purchaser if they successfully stand the test. If they do not stand the test, the cost of the rejected dozen is borne entirely by the goggle manufacturer. All the testing is done under the supervision of a representative of the purchaser.

The Joseph Dixon Crucible Co., Jersey City, N. J., has issued a card containing the formulas of a half dozen low fusion alloys together with their melting points in Centigrade and Fahrenheit, as well as the specific gravities and melting points in Centigrade and Fahrenheit of 25 metals. This card can be obtained from the Joseph Dixon Crucible Co. for the asking.

Early Manufacture of Cast Iron Stove Plate*

Magnificent Examples of the Molder's Art Which Demonstrate the Wonderful Ability of the Ancients

By John P Frey†

WHEN an effort is made to discover when cast iron first came into use, the investigator finds it impossible to secure any reliable information prior to the early part of the fourteenth century. From one or two references to iron, made by the classical authors of antiquity, some students of metallurgical lore have surmised that the Greeks and Romans knew how to make and use cast iron, but if they did, none of their cast iron products has been discovered, and their method of producing fluid iron became a lost art. Wrought iron and steel have been used since the earliest periods in human history of which there exist any record. Tubal Cain, of the seventh generation from Adam, so the Scriptures inform us, was a worker in brass and iron, and centuries later, when King Solomon was building the Temple in Jerusalem, he sent to Hiram, king of Tyre, for workmen, among whom were "workers in iron".

Aside from many references to iron in the Old Testament, there is a wealth of evidence showing that the use of iron was well known to the workmen of ancient India, Assyria, Egypt, Phoenicia and other countries of Asia. In the interior of the great pyramid at Gizeh, Egypt, an iron wedge was found under circumstances which indicated that it had been inserted between the stones some three thousand years before the Christian era. The famous iron column, which still stands, near Delhi, India, was erected about three thousand years ago. In museums there are thousands of swords, spear and arrow heads, pieces of armor and other articles of iron and steel which were in use thousands of years ago.

In fact, doubt exists today as to which primitive man discovered first, the use of iron or copper and its alloys. Among some of the remains of the prehistoric lake dwellers of Switzerland, iron articles have been found in connection with bone and

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†Editor, *The International Molders' Journal.*

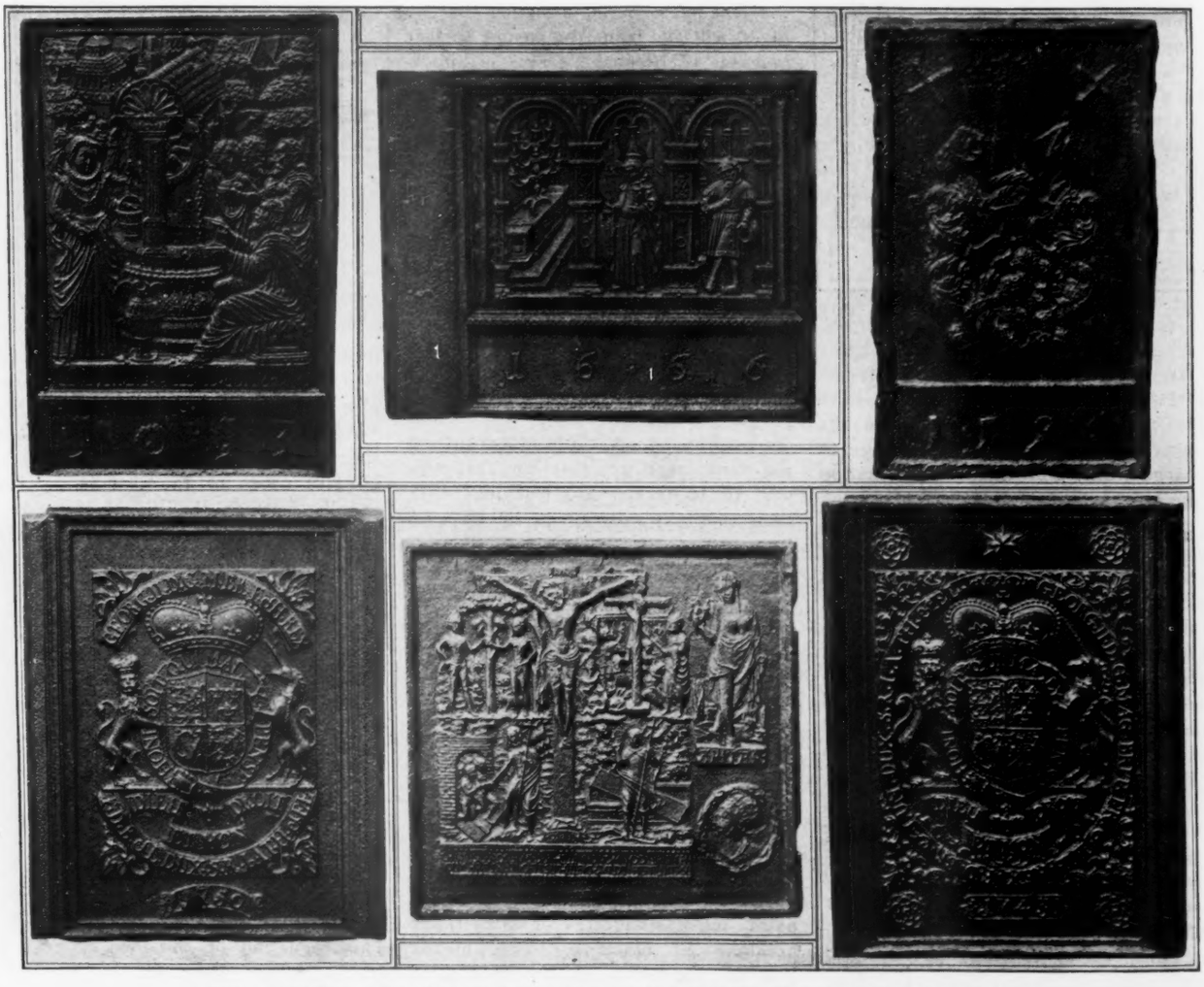


FIG. 1—VARIOUS EXAMPLES OF EARLY ENGLISH AND GERMAN STOVE PLATE

FIG. 2—EIGHTEENTH CENTURY CAST IRON MANTLE PLATE

stone implements. If it was not for its rapid rusting when damp, we would probably have many more articles produced by the early iron workers.

Among the ancients, iron was held to be much more valuable than either brass or bronze, because of its hardness, strength and quality of maintaining a sharp cutting edge, which made it valuable for weapons and cutting tools. It was also used to strengthen columns and other articles, being frequently coated with bronze or brass. There is unquestioned evidence that the ancient Assyrians understood the art of casting bronze over iron.

The primitive method of securing iron from the ore was probably similar to that in vogue today among the Zulus and some other African tribes. Iron ore was heated until it had become malleable, and then hammered and re-heated and hammered again, until the small mass had been freed from most of its impurities and hammered into the desired shape.

FIG. 3—WARMING MACHINE USED IN THE VIRGINIA HOUSE OF BURGESSES

Finally, as the centuries passed, small open furnaces were constructed, into which charcoal and lumps of ore were placed, and a weak blast supplied by means of hand or foot power bellows. This enabled the iron worker to secure a small bloom, which was removed and hammered into bars. As the size of these furnaces increased in diameter and height, water power was used to supply a stronger blast, and finally furnaces were constructed which developed sufficient heat to melt the ore, until it became fluid, and instead of blooms which were removed from the furnace and hammered into bars, the thoroughly melted ore ran to the bottom of the furnace and became cast iron. This latter stage was rapidly developed after coal as a fuel came into use.

It took countless ages, however, before men were able to produce cast iron, and in all probability the first fluid iron produced in a furnace was cast aside as a waste product. But it did not take long for the iron workers to discover the value of this new product of the furnace, and cast iron came into rapid use, and, like the original wrought iron, was largely manufactured into weapons of war.

In 1340 A. D. a furnace was erected at Marche les Dames, near Namur, Belgium, and there is a record of iron cannon being cast near Erfurt, in Thuringia, in 1377. One of the earliest authentic dates in which reference is made to cast iron is 1313 A. D., the year book of that date of the city of Ghent, Holland, mentioning cast iron cannon. In all probability the valley of the lower Rhine was the district where blast furnaces were first operated, though some contend that they had their origin in Belgium or France.

The new industry spread to England and Scandanavia, English records indicating that a Ralph Hogge was casting iron cannon in 1543, and in 1595 iron cannon weighing three tons each were being cast in Sussex. In Sweden iron cannon were being cast at the Akers foundry in 1584, and at Finspong in 1587.

It was not until the fifteenth century that cast iron was used for the purpose of making stoves, one of the earliest records being the manufacture of cast iron stoves in Alsace, Germany, in the year 1490; one of the other early records of stove foundries being that of Ilsenberg, Germany, in 1509.

These brief references to iron, and particularly cast iron, have been made as a foreword to the subject of some interesting examples of the early iron molders' art, which are now con-

FIG. 4—PART OF A GERMAN FIRE-BACK CAST IN 1549

tained in the Metropolitan Art Gallery of New York City, photographs of which are reproduced in connection with this article. All of these castings were of German make.

Cannon Balls in Clay Molds

Shortly after cast iron came into use, cannon, bells and other articles of irregular or cylindrical shape were cast in clay molds, which were thoroughly dried before the pouring was done. But open sand castings were also made in large quantities, and there was an early use made of this method for casting firebacks, oven fronts, stove tiles and interior wall or wainscoat ornaments. The open sand mold presented the opportunity for an endless variety of designs. The level sand bed, which retained every impression made upon it, offered a tempting field for the molder's ingenuity, and also for his personal mark, which was often made by impressing a finger nail, a knife, the bowl of his pipe, and perhaps the sign of his trade-union or guild.

The original stove plates were without much ornamentation, but before long the artists made dies or patterns, which were rapped into the sand bed. An example of one of these is shown in Fig. 4, a fireback cast in 1549. A close examination of this casting seems to justify the belief that the panel and border were in one piece, but that the ornamentation at the top and the date, 1549, may have been separate; also the figure of the officer, these being removed after the panel had been withdrawn from the mold.

Patterns of this type would enable the molder to use a general form for his plate with its border, and vary the figure in the center to suit the purchaser's taste or desires.

Firebacks and other castings for the huge fire places came into use before cast iron stoves were produced, and the early stoves were so expensive and rare as to be found only in the important castles, monasteries, nunneries, and the city halls of large cities.

In the early part of the nineteenth century the foundrymen began to make metal patterns for stove plate, but before that time the molders had begun to use copes on their stove plate molds. From the brief descriptions which have survived the passage of time, it would appear that in making the open sand plates the molder laid down a bed of cinders to carry away the gases, and then leveled up two iron straight edges. Loose sand was then filled in, and pressed down by rollers until the sand bed was of the necessary firmness. The pattern was then rapped to the depth of the ornamentation, and perhaps a trifle further, after which sand was rammed in around the edges of the pattern. A pouring basin would then be formed at one side of the mold, and a flow off at the other. Powdered charcoal or coke dust was used as a parting, and evidently the loose pieces containing the ornamentation were "returned," so that sharp corners would be given to the mold.

The stove built up of these plates was an elaborate affair and of large dimensions, the one in the Artushof of Danzig being 37 feet high, and when once heated by the fire within, presenting a radiating surface which must have had tremendous warming capacity. Some idea of how these plates were built up is supplied by the stove now in the capitol at Richmond, Va., which was made by a London foundryman in 1770.

Beauty and Proportion

Many of the early firebacks and stove plates were ornamented with religious subjects, or the coats of arms of noble or royal families, following in this the prevailing work of the artists of that period. The beauty and proportion of the designs on some of these plates would indicate that they were made by artists of a high order, and some now in German museums were evidently made from patterns carved by the great German genius, Albrecht Durer. Unfortunately many of the finest examples of these open sand plates were remelted when the more efficient modern stove was introduced, and there are comparatively few collections of them today, that of the Metropolitan Art Gallery of New York City being the only one known to the writer in America. In Europe the Museum de Cluny in Paris contains a fair collection, and there are others in Ilsenberg, Luxemburg, at the Halberger furnace, and in the museums of Metz, Lubeck, Nancy, Brighton and Hastings. One of the most complete collections of these plates and stoves is contained in the National Museum in Christiana, Norway, an ell of the building being devoted to them. Unfortunately these have never been photographed under the auspices of the custodians, the only ones ever taken being those which the writer secured with a small hand camera in 1909. As the light was poor, and there was no way of moving the plates so that under better illumination their beautiful and quaint designs could be done justice, the two photographs reproduced give but a faint idea of their interesting features.

It is to be regretted that so few museums and art galleries contain examples of the early iron molders' art, and that the little which has been preserved attracts but small attention. But even if the castings of early days in the history of cast iron, now in existence, were photographed and reproduced they would make a splendid collection and give evidence of the art which iron molders possessed centuries ago.

It would be a worthy monument to the memory of some foundrymen, whose wealth has come through the molders' skill and labor, if he would meet the expense necessary to gather and compile such a collection.

Death of Capt. Platt

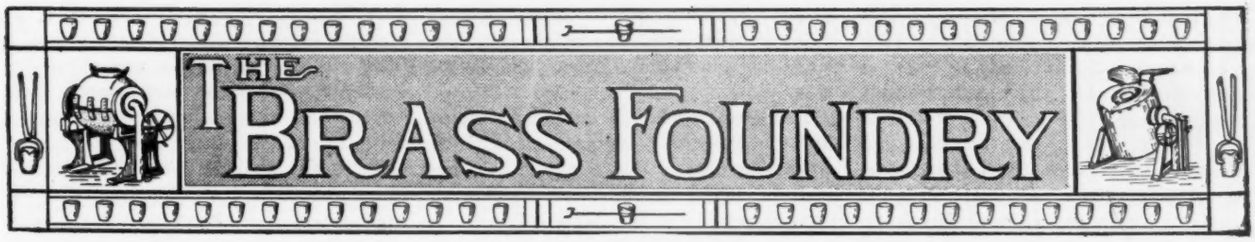
Capt. Alfred Platt, superintendent and director of the Lumberton Sand Co., a subsidiary of the J. W. Paxson Co., Philadelphia, died at his home, Bougher, N. J., May 9, at the age of 71 years. Capt. Platt entered the sand business after four years' service in the Civil War, and for several years was affiliated with John Emerick & Co. Later he was connected with J. W. Paxson & Co., and was one of the incorporators of the J. W. Paxson Co. In 1897 he was appointed superintendent and elected director of the Lumberton Sand Co. He is survived by his wife and six children.

Personals

Charlton R. Rose, for a number of years superintendent of the United States Zinc Co.'s plant, Pueblo, Colo., recently resigned his position and now is associated with Smith, Emery & Co., inspecting, testing and chemical engineers and chemists, 651 Howard street, San Francisco.

S. L. Carroll has resigned his connection with the National Transit Co., Oil City, Pa., and has been appointed superintendent of the foundry operated by the Taylor & Wilson Co., McKees Rock, Pa.

The J. S. McCormick Co., Pittsburgh, manufacturer of foundry facings, supplies and equipments, recently has completed the erection of a two-story office building, and another story has been added to the company's manufacturing building. The output of the plant has been practically doubled, and the company is in better position to meet the requirements of the foundry trade than at any time heretofore.



The High Lead Bearing Metal Problem

By Russell R Clarke

THE inability of copper to absorb naturally more than 3½ to 4 per cent of lead in a copper-lead alloy has long stimulated foundry interest in a search for some agent conciliatory to the mixing differences of these two elements. The advantage of such an alloy is not of recent recognition, though the means to the end have been slow forthcoming. Foundry rumor has it that an old German discovered the secret of holding lead in copper in the proportion of 50 and 50, and that he kept it closely guarded and permitted its interment along with his own remains. I cannot vouch for the veracity of the story, though it has gained credence in foundry circles.

By the term "high lead" I refer to a copper-tin-lead alloy whose combined tin and lead content exceeds 24 per cent of its sum total and whose tin element is less than 30 per cent of its aggregate tin and lead quota, as: Copper, 62; lead, 32; tin, 5; A, 1. The letter A is used to represent any agent auxiliary to lead retention in copper and may vary according to its nature and efficiency, from 1 to 3 per cent of the mass.

The tendency of tin to support the incorporation of lead in copper up to a fixed percentage of tin itself and to resist it when that figure is exceeded is fairly well established. This latter feature, however, calls for no discussion here since high tin is liable to little consideration in an alloy where expense and hardness are objects of elimination.

Popularity of High Lead Metal

High lead metal has enjoyed an unusual degree of prosperity and its popularity has yet to show any substantial evidence of collapse. Having the potential argument of reduced cost in its favor, it bids fair to survive its faults and rule a favorite in spite of its weakness.

I do not know if many adverse foundry opinions have been so publicly expressed before or not, but rather surmise that most foundrymen whose experience has suffered invasion from this product have privately formulated a few. In public expression, then, mine may be the first and, if so, I can look for the storm. Advocates of the alloy may rave in smothering terms about the critical and eutectic points, the matrix, the suspension of particles, the mechanical efficiency of the auxiliary, the absence of segregation and precipitation, the homogeneousness of the mass and all; but it will afford cold comfort indeed to the foundryman, who, at the close of the day's work gathers from 50 to 200 pounds of pure lead from his siftings and is forced to accept it as evidence that somewhere in his castings lurks the weakness that such a drain cannot help but produce.

In advance of the argument, it may be well to define the approximate limitations of the contention and at the same time consider briefly the properties native to the constituents of a good bearing metal along with the affinities and effects which these constituents have in varying proportions on both each other and the mass.

Elements of Bearing Metal

Experience of long standing recognized these elements to be copper, tin and lead, whereas more recent discovery sanctions the addition of phosphorus. Spelter must be excluded on account of its heating tendency in the presence of friction, while antimonial substitutes for tin merit no consideration whatever, unless brittle and treacherous castings are in demand.

Copper is the basic metal. It is tough, adhesive and highly susceptible to the heating influence of friction. It will combine naturally with tin and lead to the equivalent of a chemical union so long as the combined tin and lead content does not exceed 24 per cent of the mass and the tin approximates, at the very least, 40 per cent of the aggregate tin and lead quota.

Lead is the plastic, friction-resisting element. It will combine with tin in almost any proportions. Tin is the hardening element and gives additional strength. The effect of tin and lead on each other can easily be noted by comparing a bar of each to a similar sized bar of half-tin and half-lead solder. In this their differences are arbitrated and the product is virtually a mean between the two.

Phosphorus is used as a deoxidizing and cleansing agent. Its tendency to harden, however, should dictate caution regarding quantity. It is usually introduced through the medium of copper and in this form is known as phosphor-copper. The phosphor itself should not exceed 1 per cent of the alloy.

Variations in Quality

Variations in the quality of the mix through variations in the proportions of its constituents can easily be deduced through a consideration of the properties and primary functions of the constituents. Excess of copper pre-supposes to a more marked degree in the alloy those tough and adhesive qualities of copper, of tin or phosphorus, hardness, of lead or tin and lead inadvisedly combined—an alloy absolutely void of uniformity and decidedly porous through precipitation.

In passing it might be well also to remark that there seems to be a settled opposition between lead and phosphorus, the consequences of which increase in seriousness as the lead advances. The conclusion, then, is that a high lead mix must either lose the services of a competent deoxidizer or bide the evils such an agent will produce. Wisdom's counsel is to avoid the contention. Judgment rules against the phosphorus, and thus, unprotected, an abundance of low-melting, fast-oxidizing lead must suffer all the ruin that 2,000 degrees of heat holds within its power to create.

In the alloy under discussion the object is to drop the tin and copper as low and run the lead as high as requirements and the lead-retaining power of copper will permit, or rather in the latter case, can be enlarged. As a premise vital to logical conclusions in making up such a formula the fact should be accorded serious consideration that tin itself is a powerful auxiliary to this lead-retaining power and any attempt to raise the lead in consequence of tin reduction detracts therefrom. For instance, 10 per cent of both tin and lead in a copper-basic alloy will yield a homogeneous product free from precipitation, provided no other conflicting elements are added thereto, whereas 14 per cent of lead and 6 per cent of tin will not give equal resultant satisfaction.

Justice is only partially done tin by considering it merely an auxiliary to lead retention in copper. It is more than that. Its perfect affinity for lead and strong affiliation with copper makes it a sort of an arbitrator of their mixing differences. And it goes about its task in a business-like way parting with its own individuality in the mix and persuading a tin-lead particle to join a tin-copper particle in a tin-lead-copper union. Such a union is usually considered a chemical one, or, at least, its equivalent. At any rate, it is a logical one and a good one too. Yet even at that the tin begins to discover its weakness long before the figures of high lead are attained.

In casting, 80-10 and 10 requires no stirring to insure incorporation, though to do so is not bad practice. But castings made from 80-10 and 10, lead-sweat profusely if uncovered much above a cherry-red temperature. From this it is apparent that we are fast approaching the natural limit at these figures. A noted and very efficient chemist after repeated foundry experiments was forced to conclude that tin, 8½, and lead, 15, constituted the fixed limitations of his efforts. Nor are these proportions in the strictest sense altogether without fault. They pre-suppose many foundry precautions not necessary to 10 and 10. I make this statement in the absence of any reflection whatever on the chemist referred to. He foresaw the difficulty and forewarned against it. His object was a standard and less expensive material out of which to manufacture a large number of castings in no excessive degree particular and depended on foundry precaution to supplement what the metal in itself lacked; for it is as though the tin, refusing to treat with excess lead in the presence of copper, withdraws to the copper with its reasonable burden and leaves that excess lead to pursue its own wandering way.

This brings us to a consideration of the efficiency and extent over which an additional auxiliary exercises control, in other words, how much lead can copper be induced to retain in a low-tin-content product?

I do not propose to answer the question definitely, at least until those who have marketed their product under extravagant claims have verified those claims more satistactorily in the foundry. As both a molder and one in charge, I have had extended experience with different types of this product and I say positively that everyone within the scope of my experience is a failure so far as successful foundry manipulation is considered.

As previously stated, copper will combine with tin and lead so long as the aggregate tin and lead content does not exceed 24 per cent of the mix and the tin is at least 40 per cent of the combined tin and lead quota. I admit that these figures may be open to question, but believe they will rest defensively on the grounds of careful foundry manipulation.

Objections to Tin

The primary objections to tin are its high price—ranging from 40 to 50 cents per pound under the influence of a healthy market—while its hardening tendency is at variance with a plastic product. The object of the quest then is an auxiliary whose efficient quantity will drop to a figure whereat the expense and plastic quality of the alloy will show to greater advantage. Of those claimed to accomplish this end the author is familiar with two: Ferro-manganese and nickel as agents tributary to lead retention. They indeed merit consideration though at face value they are far beneath the extravagant claims made for them. The fact is they have been overrated and consequently overtaxed. In the premises they do not possess the qualities of a good asset. I have long entertained the notion that when a really efficient auxiliary is dug up—a holder that really will hold—it will be found to be an element possessing a strong affinity for both lead and copper and a melting point within a reasonable distance of the fusing point of the lead. But that's tin.

I have yet to be convinced that the limit of efficiency for 1 per cent nickel or 0.5 per cent of 80 per cent ferro-manganese is a high one. My opinion is firm that a single ounce of lead in excess of that in the formula: Copper, 75; tin, 4; lead, 20; nickel, 1, or copper, 75; tin, 4; ferro-manganese, 2; lead 20, is the last straw that will woefully bend the copper-camel's back. In making this statement I am not forgetful of the claim that the copper can be dropped and the lead raised 10 per cent under and over the figures given, but experience has taught me that claims do not always agree with facts.

As a part of this experience I have seen quite a few mechanics of recognized ability work this product and they all had their troubles with it. A moment's consideration of the casting peculiarities of the mix will at once expose the molder's difficulties: First, it resents hard tamping; second, it has a decided tendency to shrink, and third, it should be poured hot. Now figure what the molder has to contend with. He must use strong gate pressure to overcome cope shrinkage, but dares not tamp hard enough to support that pressure. Again, he must pour hot to avoid dirty and cold run castings. In pouring heavy work hot, the metal remains liquid in the mold for a few moments after the mold is filled and all the while the lead, the heavier metal, is sinking, settling, to the bottom; for the copper assisted by the auxiliary positively will not hold the lead in suspension. You can stir it till kingdom come and the instant you stop stirring the lead begins to settle. I have seen castings removed from the mold at a temperature above the melting point of lead and the whole bottom dropped off. I have seen them left in the mold until cold and the lowermost portions showed nothing but pure lead.

Personal experiences are not always of interest, but in support of my contention I remember starting work one morning on a large, "chunky" casting to be poured with high lead metal. The casting would weigh about 250 pounds and I figured on making five moderate-sized bushings to use up the remaining metal. It was a Saturday half-day and the one heat was all I had to make. I had plenty of time and used it principally on this mold. Knowing the nature of the metal I guarded particularly against cope shrinkage by venting well over the top and adding to my 8 inches of sand three heads or cups, each 5 inches high. This gave me a rising gate whose highest point was 23 inches above the top of the casting. As a precaution against straining or a possible run-out, I clamped a board over the cope, using four extra clamps to insure security. I poured at a warm tempera-

ture, waited one hour and uncovered a casting with a shrinkage cavity in the top large enough to accommodate all the disgust that a molder's lot is heir to. Wise heads may say I rammed too hard, had my sand too wet, used a gate too small or "done something", but men whose daily experience teaches them these precautions of the trade are not liable to go wrong when something of importance is in question and, moreover, there is something radically wrong with a metal that will not blow up a mold in consequence of hard tamping or wet sand and still shrink under 23 inches of gate pressure.

In conclusion of the tradesman's end of the discussion, I believe the remark might be generally accepted that if ever a molder jumped, crawled or was pushed between the devil and the deep sea, it all happened when he first went up against a junk-laden product that claimed high lead as its title to merit.

Lead Settling and Precipitation

Between lead settling and precipitation, a distinction must be drawn. The former occurs while the metal is liquid and merely divides the casting into portions of varying component construction. Such a fault is serious enough and at least repudiates claims made for the alloy, but it remains for the latter fault to produce the greater evil. Precipitation, as I understand it, is the oozing of lead particles from out of the vitals of the casting after the copper content has cooled to a temperature below its fusing point. Molders usually refer to this as sweating or bleeding. The sweating continues until the whole mass has cooled below the melting point of lead. In castings removed from the mold above this temperature hundreds of small, molten lead beads will appear and trickle down forming cones of solid lead at the casting's base, while those shaken-out below this temperature will have their bases embroidered with sheets of lead and the sand that supported those bases filled with isolated particles of the same material. A curious feature of precipitation is that it seldom produces visible or surface defects.

Did you ever view, with critical eye, a body of super-heated lead? How blue and purple and golden it looks! How the colors change as the eye scans the surface from different angles of vision! The surface appears sluggish and wavy. Skim it off and what have you on your skimmer? Dross, burned-up lead. The sluggish, wavy surface rapidly forms anew. Its colors come again and change again and again. Skim it off with a perforated skimmer and what have you? Dross again,—lead ashes. See how the small beads of molten lead are still dropping through the openings in the skimmer. They seem to break from a dark purple little sack and drop back into the sluggish mass again. The walls of this little sack remain on the skimmer and constitute the dross ashes to be crumbled with your fingers.

Every particle of superheated lead gathers about its exposed exterior a thin, oxidized membrane and either cools within this ashen cloak or escapes therefrom leaving it the sad heritage of its abiding place.

Advocates of high lead seem content to represent it as merely a mechanical union, their argument being that the auxiliary creates a sort of a network within the copper content between the meshes of which the lead is caught and held in suspension throughout the molten state of the mix. The stated conclusion follows that solidification will yield a uniform distribution of the lead content.

The philosophy of the whole affair was extensively reviewed in a carefully prepared statement on the subject which happened to come to my notice years ago. Even at that time I was seriously inclined to question many features of the argument and I have often wondered since how the author of that statement ever managed to haul his burden of proof through such crooked avenues of reason or on such dilapidated premises to such exaggerated conclusions, for if his reasonings were just, his premises were false; whereas, stability of premise predicts error in reason when results fail to substantiate conclusions. As I remember it now I am inclined to believe that in making up his data the author first stated his conclusions and then scratched his head for premises.

However, admitting for argument's sake the justice of the contention, the evil still cries out against it. If the mix is merely a mechanical union of the lead and copper content then the lead retains its identity in the mix. If molten lead retains its identity entangled in the meshes of molten copper, what will happen to molten lead? But the lead will not all remain in suspension. It will sweat-out of the ingot long before the copper content shows any signs of melting, settle to the bottom of the container and remain there if not disturbed during the entire process of melting. Any experienced eye will detect normal copper on the surface of a pot of this molten metal undisturbed, whereas if you were to pour four or five molds without vigorously stirring, the first castings would be little above normal in lead, whereas those poured last would contain scarcely 30 per cent of an entire copper content. It is to be understood, however, that these four or five molds will use up all the metal contained in the container and that the remarks in general concerning lead sweating and segregation, under the most careful foundry manipulation, cannot be rigidly applied to light castings or castings whose surface area figures are many times their solid content figure, or ingots poured into cold cast iron chills. In the first named cases solidification of all constituents is so rapid that the lead content, being stirred into position, has little time to get started until it finds itself chilled above a running temperature, while in the last named particular, gravity can be made the medium of a mechanical trick. Thus, a test for a bar, 1 inch square by 12 inches long, cast either in a sand or chill and containing a surface area figure 4.16 times its solid content figure, will support a creditable showing when the lead runs as high as 30 per cent, but this does not justify the conclusion that a casting 8 inches in diameter by 14 inches long will measure up to the same homogeneous standard.

Praises of 50-50 Metal

Years ago a man came to a shop singing the praises of a product that would hold lead and copper 50 and 50. We were not prepared for anything so sudden and to guard against heart trouble requested that he first show us how with 60 and 40. He tried and charged his failure to improper furnace manipulation. We then granted him the requested privilege of using his own furnaceman and the second test was on. The metal was melted, the molds poured and the castings later removed in separated chunks of lead and copper. Every detail of the test was superintended by the advocate of the product in person, yet his claims lay a corpse at his feet. His parting words were that he himself was pretty hard to kill and we could look for him back very much alive soon again. I have never noticed his obituary in the papers, but he must have died or wandered far away.

Recurring again to the permanent evil superinduced by excessive heat and magnified through precipitation, I solicit judgment influenced only by unbiased consideration of the facts in

the case. Lead melts at 330 degrees Cent., and copper, at 1,060 to 1,090 degrees Cent. Multiplying by 1.8 we pass from Cent. to Fahr. and find the figures to approximate 600 degrees and 2,000 degrees. Twelve hundred degrees Fahr. is amply above the fusing point of lead to burn it. The union of lead and copper is admittedly mechanical and the lead retaining its identity throughout the melting and molten state must suffer all the evil that 800 degrees Fahr. of super-excessive heat is capable.

Stirred to incorporation when cast, the little of excessive lead remaining in the network—if there really be a network other than granular copper lines intersecting in their wanderings for affinity—still retains its identity until the precipitation sets in, when its particles break their ashen walls and ooze away. Then what becomes of the dross since the copper content is solid and will not permit its escape? The mesh of excessive lead that settles to the lowermost surface of the casting has escaped downward through the network. Do you suppose its dross has evaded the meshes?

Scrap Deterioration

Between the two I hold precipitation to be the greater evil because it occurs when the copper content is solid, thus creating a vacancy that cannot be filled, superinducing porosity and representing an absolute loss to the casting. From this rational consideration of well-known facts I deduce as a justly premised conclusion my final and most serious objection to the alloy, that of its scrap deterioration. Constant addition of new material in most liberal quantity alone will avoid the most serious foundry consequences. The return of scrap is the return of almost worthless junk. No two pieces are strictly alike in composition nor can they ever be until segregation and precipitation conform to fixed and uniform control or the excess lead is dropped altogether. The scrap approaches similarity in one respect alone, every piece contributes its full quota of dross, or oxide or whatever you may choose to call it and gives a most undesirable product in recasting.

For this, patterns have been increased in dimensions to give additional stock to castings. For this, castings have been taken from lathes after machining and broken in two when dropped on the floor; for this, long, longitudinal lines of parting dross have opened up crevices throughout the entire length and thickness of castings in the process of machining; for this, bushings have crushed when pressed into rods; for this, the great majority of the many castings I have observed clean and cold-broken have shown long lines and large sections of dross and oxide and porosity, and for these faults foundries have received many curses, sometimes loud and always deep.

The value in service of such an alloy successfully manufactured cannot be questioned, though its real worth is extensively modified through assignment of position. Where friction is created through a constant in pressure, its plastic and anti-frictional qualities yield unquestioned advantage, though the former decrees against it in positions where sudden changes in the direction of pressure creative of a pounding effect are in evidence. Thus it is admirably adapted to a crown brass, but entirely out of place in a rod.

It would be an open breach to leave unwritten the precautions I have taken to overcome the evils I have detailed, and those who may dispute my statements may seize this as their opportunity in rebuttal. If they have any information to offer I shall be only too glad to receive it and promise to openly confess my ignorance and repent in case their suggestions solve the difficulty.

Experience has taught me to expect best results through observation of the following:

If melting and casting from virgin constituents, bring the copper and all other high degree melting elements to a liquid state before adding any low degree melting element.

Don't superheat the metal.

Use a reliable flux.

Keep the surface of the metal well covered with crushed charcoal during its melting, molten and pouring state.

Use sand rather dry and of good body.

Tamp uniformly, carefully varying in degree with respect to vicinity.

Vent the mold freely.

Use strong gate or sprue pressure.

In pouring hold a skimmer in position on the lip of the container, keeping the charcoal covering close thereto, thus subjecting to a minimum the molten metal to the oxidizing influence of the atmosphere.

Pour hard and at a warm temperature filling the mold as quickly as possible.

In castings of sufficient depth, gate from the bottom invariably.

Uncover the castings above a cherry-red temperature, permitting the atmosphere to aid in the rapid reduction thereof.

Melting conditions are most important considerations.

The metal should be vigorously stirred before pouring each mold, though this is in itself an admission of the metal's weakness.

Results are the just and final test of every foundry proposition. The logic of all contrary reasoning pales before them. "It ought to", "everything is in favor of it", "there is no reason why it should not", "common sense vindicates it", are statements idle as the thought that calls them forth when results decree against them. In the last analysis, facts dominate all arguments, eliminate or establish all propositions, theorems can be reduced to absurdities or explained away, opinions reasoned to falsities, but facts are stubborn things and must be reckoned with to the end.

Before concluding my argument against this alloy, I feel it justly a part thereof to state that I have no quarrel whatever with its advocates. My opinions are against their product alone and have been formulated only after a long and careful consideration of the evidence so abundantly furnished. In my statements I have reckoned with facts only and the conclusions I have drawn rest firmly on those results my 10 years' experience with this metal has enabled me to observe.

Less Plastic Product Useful

In the interests of their product those advocates may feel inclined to dispute my figures and my claims. Any such attempt I should consider a perfectly natural course and would welcome it hoping that some yet unexplored mines of information to me may be opened up. I am willing to consider some new "Missouri compromise" or will gladly bide the inconvenience of an intellectual "crack on the dome" if light will only enter in consequence.

The drift of my argument has thus far clung to those features of the alloy supporting its condemnation. Destructive of something and creative of nothing in substitution. My personal opinion of the successful and efficient quantitative constituency of a high lead mix may be of little worth, yet curiosity on the part of some may attach sufficient interest thereto to justify its expression. I believe a less plastic product to be of greater all around value and to successfully attain and maintain its consistency would use the following: Copper, 73 per cent; lead, 18 per cent; tin, 6 per cent, and ferro-manganese, 3 per cent.

I believe that a chemical analysis of castings made from a mix contain-

ing originally 30 per cent of lead will show, at least on second melting, that the lead content is as close to the 18 per cent formula as to the original 30 per cent mix, and that the castings are far inferior to those of this 18 per cent mix.

To me the most foolhardy thing of all is to put the lead in only to see it run out again or settle to parts of the casting where it is absolutely of no consequence. The wisdom of such a policy is on a par with that of loading a gun barrel with more powder than it will burn or pouring more water on a sponge than it is capable of absorbing.

With reasonable faith in this 18 per cent mix, I must still confess that if the machinery to be equipped and the foundry to produce were my own, I would consider it penny-wise and pound-foolish policy to adopt a metal even thus conservative.

The old bearing metal, 80, 10 and 10, has been the heritage of mechanical generations. Long years before the modern mammoth journal turned its two and one-half hundred to the mile or the minute, sore pressed by the two and one-half hundred thousand pounds above it; when the wonder of the day was as we see it now, a mere iron toy girdled and tipped with polished brass, founders made bearings of 80, 10 and 10, and mill and factory and the little iron horse found it good. Oxide bothered, so metal man and foundryman tried phosphorus and mill and factory and the little iron horse found it better. They have yet to answer "best". In spite of effort, in spite of claim the superlative of the comparison lies still in the distance. Some day we may reach it, mayhap through lead, but the goal lies beyond a mere mechanical union.

To my own foundryman, for my own bearings, I would say: Of good selection take copper, 79 per cent; tin, 10 per cent; lead, 10 per cent, and phosphorus, 1 per cent, and make me bearings.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Overcoming Shrinkage in Bronze

A small bronze plate casting, ¼ inch thick and weighing about a pound, shows a cavity near one end near the gate. There are six castings in the mold with a sprue, 1-1/16 inches in diameter. The difficulty arose after the thickness of the gate had been lessened to make sawing easier. The mixture is 60 per cent copper, 36 per cent yellow brass, 2 per cent tin and 2 per cent lead. Can you tell us what causes the cavity in the casting?

The splitting of the plate is due to shrinkage. The gate is so small that it solidifies before the casting and, therefore, when the metal sets, there is no outside reserve supply of liquid metal, on which it can draw to make up for the shrinkage. If the castings were of heavier section, there would be a depression or shrink somewhere on top or a deep tortuous hole would be revealed when the gate is cut off. In the case of a thin section the shrinkage can occur only at the center and takes the form of a split or crack, because that is the point where the metal solidifies last, due to the chilling action of the mold. This difficulty can be avoided by properly feeding the casting as it shrinks. An excellent object lesson in feeding the casting can be obtained by viewing any well designed patterns gated for malleable iron. Such patterns usually have a very thin gate at the point where the gate enters the casting, but it is heavy where it is joined to the runner, the heavy section being largely in the cope. The result is that the thin gate is kept from setting by the heavy section at one end and, therefore, the casting solidifies first and draws metal from the reserve back of the gate to compensate for shrinkage. If it is desired to retain the thin gate, place shrink balls in the cope at the junction of the gate and runner and do this for each casting. On the other hand, a double runner can be used, that is, a runner partly in the cope and partly in the drag, the cope part being the highest.

Aluminum Solder

In the January, 1914, issue of THE FOUNDRY *was published an aluminum solder mixture, which contains, zinc, 25 per cent; tin, 69 per cent, and aluminum, 6 per cent. Can this be used for soldering aluminum to aluminum and how should it be melted and fluxed?*

To make the alloy, first melt the zinc, add the aluminum and after removing the crucible from the fire, add the tin. This formula is only one of the many alloys intended for soldering aluminum and it may succeed or fail according to the manner in which it is used. It is well known that aluminum is a difficult metal to solder satisfactorily and even when soldered, the permanency of the work frequently is doubtful. The difficulty experienced is due to the film of oxide which covers all aluminum surfaces and which is not removed by the soldering fluxes ordinarily used for other metals.

Aluminum Match-Plate Mixture

We would like to have an aluminum match-plate mixture, as we have experienced considerable difficulty in casting an alloy consisting of 2 parts of aluminum and 1 part of zinc. The cope side of the castings is smooth, but the drag sides are rough and it seems as if the metal does not mix properly.

An alloy consisting of 2 parts of aluminum and 1 part of zinc is difficult to cast in sand molds, inasmuch as the slow cooling permits of segregation, with the result that the bottom of the casting consists of a rich, zinc-aluminum alloy having a tendency to form long, needle-like, interlacing crystals which produce a rough, uneven surface on the casting. In addition, the upper part of the casting consists of an alloy richer in aluminum than the remainder, and consequently is of lowest specific gravity and does not crystallize the same as the heavy alloy on the bottom. Therefore, the casting is smooth and sound on top and defective on the bottom, a condition which can be remedied only by chilling the metal so rapidly that time is not allowed for segregation. As this method is not practical with ordinary molding processes, the only alternative is to abandon the use of this alloy and to replace it with one free from this excessive tendency to segregate. We would suggest that you do this in the present case. An alloy consisting of aluminum, 92 per cent, and copper, 8 per cent always can be depended upon to give good results. Another alloy which will prove

satisfactory, and which is somewhat cheaper than the foregoing, consists of aluminum, 82 per cent; copper, 3 per cent, and zinc, 15 per cent.

Core Mixture for Phosphor Bronze

We would like to have a core mixture for phosphor bronze, one that will be impenetrable to the metal. Also we would like to have some suggestions for building a small air furnace for melting about 2,000 pounds of brass at one heat.

Phosphor bronze will penetrate any core provided the metal is poured hot and the core is not protected by blacking. An oil-bonded core is as satisfactory as any that can be employed. Linseed oil, or any other commercial oil, also may be used. The proportion of oil to sand can vary from 1 of oil to 32 of sand to 1 of oil to 50 of sand, by weight, the sand being dry. The proportion of oil used will depend upon the manner in which the sand and oil are mixed. More oil is required in the case of hand mixing than machine mixing. The important feature is the protection of the core with plumbago. Mix the plumbago with strong molasses water to the consistency of a paste and apply to the core with the hand by rubbing until a smooth, uniform coating is obtained. Then the core should be dried.

The old type of air furnace for melting bronze in bulk, to a large extent, has been superseded by the modern, oil-fired, open-flame furnace, which can be furnished in capacities ranging from 1,000 to 30,000 pounds of metal per heat. Details regarding these furnaces and the work which they can perform can be obtained from any of the well known builders of equipment of this type, whose addresses can be secured from the advertising columns of THE FOUNDRY.

Metal Pattern Mixture

Can you furnish us with a mixture of lead, antimony and tin, which is more or less nonshrinkable and from which we can make patterns to mount on plates. We have experienced considerable difficulty in making satisfactory castings that are smooth and easy to finish. We have employed plaster of Paris, as well as mixtures of plaster of Paris and fine asbestos, but the molds do not seem to be satisfactory.

Where the patterns are cast separately from the plates and after being finished are mounted thereon, it is better to cast them of bronze because it will wear better than white metal, and the cost of finishing is not much greater. If the plates and patterns are cast in one piece the best material to use for the purpose is aluminum, because of its low specific gravity. White metal is too soft for making good patterns, and at the same time is more expensive than either bronze or aluminum. It has the advantage, however, of shrinking less than either of the other metals mentioned. The following alloys are easily cast and will produce smooth castings, provided the molds are made of a fine sand:

Alloy No. 1: Tin, 40 pounds; lead, 50 pounds, and antimony, 10 pounds.

Alloy No. 2: Lead, 72 pounds; tin, 18 pounds, and antimony, 10 pounds.

If a non-shrinking alloy is required, the following will be found satisfactory: Lead, 43 pounds; tin, 40 pounds; antimony, 13 pounds, and bismuth, 4 pounds.

Carburetor Mixture

Will you kindly furnish us with a mixture for carburetors? We would like to melt this metal in a Hawley-Schwartz furnace which has a capacity of 100 pounds per heat.

For casting carburetors the following alloy is recommended: Copper, 86½ pounds; tin, 8 pounds; zinc, 3½ pounds, and lead 2 pounds. There is no reason why this alloy or any other cannot be melted in an open-flame furnace.

Metals Recovered From Waste in 1913

THE value of the "secondary metals", exclusive of gold, silver, platinum and iron, recovered in the United States in 1913, was $72,845,000, according to J. P. Dunlop, of the United States geological survey. Even this large figure is a decrease compared with 1912, when the value was $77,396,000.

"Secondary metals" are those recovered from scrap metal, sweepings, skimmings, drosses, etc., and are so called to distinguish them from the metals derived from ore, which are termed "primary metals". The distinction does not imply that secondary metals are of inferior quality. The reports to the survey do not include the very large quantity of old iron and steel remelted, neither do they include the precious metals. In fact, while the data given in this statement cover a large field and form an essential addition to the reports on primary metals, the scope of the inquiry made by the survey reveals only in a partial way the vast extent of the waste trade industry, which yearly becomes greater and better organized. The survey's inquiry was extended in 1913 to cover secondary aluminum and the result appears to have justified the extra effort. The values given for the secondary metals are arbitrary and are based on the approximate average value of the primary metal for the year.

Scrap and Drosses

While the junk dealer buys small and scattered quantities of scrap metals at low prices which enable him to resell the material at a substantial profit regardless of the changing value of primary metal, the keen competition for large quantities of drosses and carefully sorted scrap metals results in good prices being paid for such waste materials. In fact, it appears that in 1913 the decline in metal prices and the slackened trade conditions, combined with sharp competition, raised comparative prices of scrap and drosses until the margin of the large jobbers, smelters and refiners handling this material was too small to permit very profitable operation. Although the quantity of reclaimed metal compared favorably with that of former years, stocks of metal derived from scrap and drosses were much larger at the end of 1913 than in 1912. After remelting or refining, these secondary metals, selling at only slightly lower prices than new metal, displace an equivalent quantity of primary metals and must be considered in any estimate of stocks available for consumption in any year. For a few purposes requiring especial purity of material, it is necessary to employ primary or virgin pig metal, but as a general rule, secondary metals can be used in whole or in part. In fact, most foundries, in order to compete for business successfully, must and do use secondary material, at least in part, and hence they purchase scrap metal and remelt it with primary pig metal or with composition ingot.

The secondary smelters, by handling large quantities of all kinds of scrap, are able to classify their material so as to produce continuously alloy metals of uniform composition suitable for use in work of different classes. Such composition ingots are being purchased and used in increasing quantities by many foundries and other

manufacturers in place of primary metals or mixtures of new and scrap metals.

It has so far proved impossible to separate the statistics for secondary metal recovered from clean scrap made in the ordinary course of manufacture from the statistics of metal recovered from drosses and ashes and from scrap or old metal that had entered the trade as manufactured articles and been discarded. An estimate of the clean copper and brass scrap on the basis of replies from the larger secondary smelters and refiners, but no classification made by many of the dealers or smelters is available.

Recovery Increases

The use of magnetic separators to free scrap from iron, the recovery of metal from cinders and molding sand, and the use of machines to briquet small scrap in order to reduce the losses in melting continued to increase. Dealers and jobbers in scrap metal realize the necessity of combining to insure better grading of waste metals and more efficient methods of packing in order to obtain lower shipping rates. The large smelters and refiners of waste metals and drosses, many of whom conduct a business amounting to millions of dollars yearly, recognize the importance of proper separation and grading of metal wastes and of selling alloys of guaranteed composition, but the smaller manufacturers and metal buyers have not been as careful as they might have been in view of the undoubted fact that the larger portion of all waste material is collected by junk men and jobbers, who resell the material to the smelters, refiners or manufacturers. The use of old metals has extended rapidly, and any co-operation that will remedy trade objections to the use of secondary metals in any branch of manufacturing, as well as any saving that lowers the cost of treating waste products, must result in a broader market and prices more nearly approaching those for virgin metal.

It is impracticable to segregate the statistics relating to the refining, remelting and re-use of secondary metals according to states, but over 90 per cent of the refining and smelting of drosses and scrap metals in the United States is confined to the territory east of St. Louis and north of the Ohio river. Reports were made by approximately 550 users of secondary material, of which about 150 were in Pennsylvania and West Virginia, 130 in New York, New Jersey, Connecticut, Maryland and Massachusetts, and 150 in Ohio, Indiana, Illinois and Michigan. Over 60 per cent of the secondary aluminum was reported from the states of Ohio, Illinois and Michigan. Smelters and refiners in St. Louis, Chicago, Cincinnati, New York and Philadelphia recovered over 80 per cent of the antimony in alloys. The larger portion of the secondary tin was refined by plants in Pennsylvania, New Jersey and New York. The recoveries of lead, zinc and copper were more generally distributed. The greater number of the larger smelters or refiners of secondary metals are located at or near New York, Philadelphia, Pittsburgh, Tottenville (N. Y.), Chicago, Cincinnati, St. Louis, Detroit and Cleveland, though there are many large plants at other places.

The total amount of secondary copper recovered in 1913, on the assumption that the brass remelted had an average copper content of 70 per cent, was 136,500 tons, of which 18,661 tons (about 4,000 tons more than in 1912) was recovered by plants refining primary metals and the remainder by plants treating only secondary materials. The copper produced by smelters of the latter class includes 36,716 tons of pig copper, 11,603 tons of copper in alloys other than brass, and 69,520 tons of copper in remelted brass. These figures indicate a decrease for 1913 of about 6,000 tons of pig copper, and 1,500 tons of copper in brass and an increase of about 2,300 tons in alloys other than brass. At least 45,000 tons were recovered from clean scrap made in the course of manufacture of copper and brass ware, so that only about 91,500 tons were obtained from ashes, cinders and scrap, or from material that had actually been used and discarded. According to the bureau of foreign and domestic commerce, the exports of scrap brass fit only for re-manufacture, for the calendar year 1913, were 10,943 tons, and the imports were 3,395 tons. While many railways sell or turn in the larger portion of their brass and copper scrap and other metal waste to dealers in part payment for new material, the reports received show that the railways utilized in their own shops and foundries over 12,670 tons of brass, in addition to 900 tons of copper and 2,828 tons of copper in alloys other than brass.

The production of copper from secondary sources in 1913 was equal to about 17 per cent of the refinery output of primary copper in the United States from all sources, or about 22.4 per cent of the primary copper smelted from domestic ore.

The secondary lead recovered in 1913 amounted to 72,834 tons or about 5,700 tons more than in 1912. The secondary lead recovered as pig lead increased about 2,800 tons, a normal increase in view of the fact that the average lead price was nearly the same in 1912 and 1913. The recovery of lead in alloys increased 2,900 tons compared with 1912. The increase of 2,800 tons of pig lead from secondary material was due wholly to the increased recoveries made by those regular smelters whose product is mainly primary metal. The increase reported to the survey in the quantity of lead in alloys, much of which is derived from remelted babbitt and bearing metals, was doubtless due in part to a more careful canvass of the scrap metal dealers, who not only act as brokers and middlemen, but frequently remelt and sell babbitt, lead pipe and spelter. Other important sources of secondary lead were old pipe, lead

PRODUCTION OF SECONDARY METALS IN THE UNITED STATES IN IN 1912 AND 1913

Metal.	1912 Short tons.	1912 Value.	1913 Short tons.	1913 Value.
Secondary copper, including that in alloys other than brass	66,441	$21,593,325	66,980	$20,536,068
Remelted brass	101,523	27,279,516	99,315	24,651,969
Secondary lead	30,266	6,045,120	33,104	6,409,392
Recovered lead in alloys	36,902		39,730	
Secondary spelter	52,251	7,750,494	50,005	6,019,776
Recovered zinc in alloys other than brass	3,912		3,743	
Secondary tin	8,333	14,301,368	6,415	12,567,379
Recovered tin in alloys	7,068		7,763	
Secondary antimony	13	426,020	45	460,932
Recovered antimony in alloys	2,493		2,660	
Secondary aluminum	.....	.....	2,198	2,199,480
Recovered aluminum in alloys	.....	.....	2,456	
Total value	.....	$77,395,843	.....	$72,844,996

linings of acid tanks, and drosses from white metal alloys. Regular smelters reported the recovery of 9,328 tons of lead from lead and antimonial lead scrap. The total output of secondary lead was equal to 15.2 per cent of the refined lead produced in the United States in 1913, compared with 13.5 per cent in 1912, or to 16.7 per cent of the refined lead produced from domestic ores in 1913. It was exceeded by the domestic lead output of only two states, Missouri and Idaho, and only one other state, Utah, had an output of lead nearly as large as the secondary lead recoveries.

Decrease in Secondary Spelter

The output of secondary zinc (including that in brass) amounted to 79,570 tons and equaled 23 per cent of the total production of primary spelter in the United States in 1913, compared with 24.1 per cent in 1912. The zinc recovered in alloys other than brass amounted to 3,743 tons, compared with 3,912 tons in 1912. Of the 50,005 tons of secondary zinc recovered as spelter, 25,991 tons were obtained by redistillation from drosses, skimmings, etc. In addition to the large quantity of spelter recovered, it is estimated that over 15,000 tons of zinc chloride was made from drosses, skimmings, etc., and likewise several thousand tons of the zinc pigment lithopone.

The quantity of spelter recovered by redistilling drosses, skimmings, etc., was about the same in the years 1912 and 1913. Two zinc smelters in New Jersey and Pennsylvania which recover spelter entirely from drosses, skimmings, etc., used large 800 or 1,000-pound retorts instead of the small ones used by smelters treating ore or mixed ore and drosses. A large portion of the secondary spelter recovered was reported to be of high grade, ranging above 99 per cent pure and equal in practically every respect to the spelter made from ore. The quantity of secondary spelter produced by smelters having an output derived mainly from ores increased about 1,800 tons. This would apparently indicate that the practice of mixing zinc concentrates and drosses is extending. Although prices of spelter were much lower in 1913 than in 1912, the exports of zinc dross amounted to only 28 tons, compared with 205 tons in 1912 and 4,246 tons in 1911.

The production of secondary antimony, of which all but 45 tons was recovered in alloys, increased from 2,506 short tons in 1912 to 2,705 tons in 1913. The only antimony ore of domestic origin smelted in the United States in 1913 was 116 tons from Nevada, which was mined prior to 1912. The regular smelters reported the recovery of 92 tons of antimony contained in antimonial lead scrap. The principal materials refined or remelted which contained antimony as an alloy were hard lead drosses, babbitt, solder, pewter and type metal. The 1913 imports of antimony as metal, in ore, or as oxide, amounted to 7,692 tons, and the recovery from secondary sources was equal to 35.1 per cent of the imports. The secondary recoveries of antimony were 500 tons more than the antimony content of antimonial lead or antimony ores of domestic origin smelted in 1913.

Apparently there were no domestic tin ores smelted in the United States in 1913, though some tin concentrates were shipped from Nome, Alaska, Gaffney, S. C., and Spearfish, S. Dak., to Great Britain for treatment. This condition makes secondary tin an important factor in supplying domestic consumption. The secondary tin recovered in 1913 was equal to 27.2 per cent of the tin, as metal or as oxide, imported into the United States during the year (52,141 short tons). Secondary tin recoveries decreased from 15,401 tons, valued at $14,301,368, in 1912, to 14,178 tons, value at $12,567,379 in 1913. The quantity recovered as tin was 6,415 tons and that in alloys and chemical compounds 7,763 tons. It will be noted that the secondary tin in alloys increased about 700 tons, an increase similar to that of lead in alloys. The secondary pig tin decreased about 1,900 tons, for although the reports showed that the recoveries from scruff and drosses compared favorably with former years, the recoveries from clean tin scrap, tin foil and tin pipe were appreciably less in 1913 than in 1912. This condition was natural, for the use of tin foil and block tin pipe has not expanded and the recoveries from those sources are relatively small. The quantity of clean tin scrap treated was considerably less in 1913 than it was in 1912. This was partly due to the burning of the Vulcan Detinning Co.'s electrolytic plant at Sewaren, N. J., and to decreased operations of several other users of clean scrap tin. There was no great incentive to treat tin scrap which had been contracted for or purchased at prices that precluded much profit at the prevailing lower prices of pig tin in 1913.

The dry chlorine process was used to recover the tin from the clippings in some places. In others reverberatory furnaces were used to remove the tin coating, and a large quantity of tin was recovered in the form of a tin powder by the electrolytic treatment of clean scrap, the powder being sent to secondary smelters. The largest recoveries of tin were made from the scruff and drosses that occur in making tin and terne plate and amounted to over 5,000 tons. Only one firm reported using old tin containers, from which the tin and solder were first sweated and the black plate remelted to make sash weights. Comparatively large quantities of tin scrap and old tin cans are used in the western mining regions for the precipitation of copper from mine waters. Such scrap is plentiful, cheap and fairly well adapted for the purpose. However, the tin coating of the scrap does not enter into the reaction and is lost entirely. The principal alloys in which secondary tin was recovered were babbitt and other bearing metals, bronze, solder, pewter and electrotype metal.

Aluminum Recovery

For the first time the survey obtained statements of the quantity of secondary aluminum recovered as pig aluminum or in alloys, and while the inquiry may not have reached all producers the result showed that the percentage of secondary aluminum used compared with virgin metal was fully as large as in other non-ferrous metals. The recoveries in 1913 amounted to 4,654 tons, valued at $2,199,480. Of the 4,654 tons the quantity recovered in alloys amounted to 2,456 tons, and over 90 per cent of this was an alloy of 92 per cent aluminum and 8 per cent copper, used for making sand castings. It is probable that a large part of the secondary pig aluminum was recovered from clean clippings and borings and that it also was utilized in making castings.

Loss of Weight From Annealing

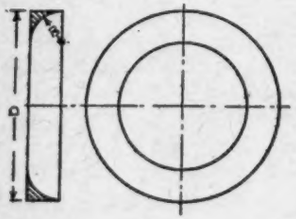
By W. J. Keep

Question:—In adding the weights of the hard iron castings that are put into our annealing ovens and the weights of our shipments for a given time, say, six months, we invariably find a discrepancy, even after allowing a certain percentage for loss of sand and loss of castings in tumbling. Could you inform us what effect that the annealing process has on the weight of the hard iron castings? Do they weigh more or less after annealing?

Answer:—Castings after annealing weigh from ¼ to 1 per cent less than before annealing. This is not due to scaling, but is assigned to the loss of carbon from the skin of the casting during the annealing process.

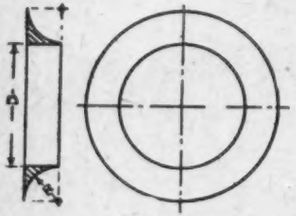
FORMULAE FOR FINDING THE WEIGHTS OF CASTINGS

By W. L. Tryon



To find the weight of an inside circular fillet, multiply the difference between the diameter of the cylinder made by the side of the fillet and the product of the radius and 0.446, by the radius squared, by the constant K corresponding to weight per cubic inch, or from the diameter of the cylinder made by the side of the fillet multiplied by the radius squared by the constant K, subtract the radius cubed multiplied by constant M. (See table below.)

$$W=(D-0.446R)R^2K \text{ or } W=DR^2K-R^3M$$



To find the weight of an outside circular fillet, multiply the sum of the diameter made by the side of the fillet and the product of the radius and 0.446 by the radius squared by the value of K, or

To the diameter of the cylinder made by the side of the fillet multiplied by the radius squared by the constant K, add the radius cubed multiplied by the value of M.

$$W=(D+0.446R)R^2K \text{ or } W=DR^2K+R^3M$$

ALL DIMENSIONS IN INCHES AND WEIGHTS IN POUNDS.

Wt. per cu. in.	K	M	C	Wt. per cu. in.	K	M	C	Wt. per cu. in.	K	M	C
.096	.0647	.0289	.0105	.250	.1686	.0752	.2617	.410	.2764	.1233	.4293
.100	.0674	.0301	.1047	.260	.1753	.0782	.2722	.420	.2832	.1263	.4398
.110	.0742	.0331	.1152	.270	.1820	.0812	.2827	.430	.2899	.1293	.4503
.120	.0809	.0361	.1257	.280	.1888	.0842	.2931	.440	.2966	.1323	.4607
.130	.0876	.0391	.1361	.290	.1955	.0872	.3036	.450	.3034	.1353	.4712
.140	.0944	.0421	.1466	.300	.2023	.0902	.3142	.460	.3101	.1383	.4817
.150	.1011	.0451	.1571	.310	.2090	.0932	.3246	.470	.3169	.1413	.4922
.160	.1079	.0481	.1675	.320	.2157	.0962	.3351	.480	.3236	.1443	.5027
.170	.1146	.0511	.1780	.330	.2225	.0992	.3456	.490	.3304	.1473	.5131
.180	.1214	.0541	.1885	.340	.2292	.1022	.3560	.500	.3371	.1503	.5236
.190	.1281	.0571	.1989	.350	.2360	.1052	.3665	.510	.3438	.1533	.5341
.200	.1348	.0601	.2094	.360	.2427	.1083	.3770	.520	.3506	.1563	.5446
.210	.1416	.0631	.2199	.370	.2495	.1113	.3874	.530	.3573	.1594	.5550
.220	.1483	.0662	.2303	.380	.2562	.1143	.3879	.540	.3641	.1624	.5655
.230	.1551	.0692	.2408	.390	.2629	.1173	.4084	.550	.3708	.1654	.5760
.240	.1618	.0722	.2513	.400	.2697	.1203	.4189	.560	.3776	.1684	.5864

INTERPOLATION TABLE.

Add'l wt.	Add'l K	Add'l M	Add'l C	Add'l wt.	Add'l K	Add'l M	Add'l C	Add'l wt.	Add'l K	Add'l M	Add'l C
.001	.0007	.0003	.0010	.004	.0027	.0012	.0042	.007	.0047	.0021	.0073
.002	.0013	.0006	.0021	.005	.0034	.0015	.0052	.008	.0054	.0024	.0084
.003	.0020	.0009	.0031	.006	.0040	.0018	.0063	.009	.0061	.0027	.0094

(For method of interpolation, see Data Sheet No. 129.)

DATA SHEET NO. 163, THE FOUNDRY, JUNE, 1914.

FORMULAE FOR FINDING THE WEIGHTS OF CASTINGS

By W. L. Tryon

To find the weight of a spherical segment of one base, multiply the square of the height by the difference between the radius of the sphere and one-third of the height by the value of k corresponding to the weight per cubic inch of material used, or, to the radius of the base squared multiplied by the height by the value of m add the height cubed multiplied by the value of c.

$$W=\left(R-\frac{H}{3}\right)H^2k \text{ or } W=r^2Hm+H^3c$$

To find the weight of a spherical segment of two bases, from the radius of the sphere multiplied by the difference between the squares of the distances from the bases to the pole by the constant k, subtract the difference between the cubes of the distances from the bases to the pole multiplied by the constant C, obtained from the table on Data Sheet No. 163, or to the sum of the squares of the radii of the bases multiplied by the height by the value of m, add the height cubed multiplied by the value of c.

$$W=(A^2-B^2)Rk-(A^3-B^3)C \text{ or}$$
$$W=(r^2+s^2)Hm+H^3c$$

ALL DIMENSIONS IN INCHES AND WEIGHTS IN POUNDS.

Wt. per cut. in.	k	m	c	Wt. per cu. in.	k	m	c	Wt. per cu. in.	k	m	c
.096	.3016	.1508	.0503	.250	.7854	.3927	.1309	.410	1.288	.6440	.2146
.100	.3142	.1571	.0524	.260	.8168	.4084	.1361	.420	1.319	.6598	.2199
.110	.3456	.1728	.0526	.270	.8482	.4241	.1414	.430	1.351	.6755	.2251
.120	.3770	.1885	.0628	.280	.8796	.4398	.1466	.440	1.382	.6912	.2303
.130	.4084	.2042	.0680	.290	.9111	.4556	.1518	.450	1.414	.7069	.2356
.140	.4398	.2199	.0732	.300	.9425	.4712	.1571	.460	1.445	.7226	.2408
.150	.4712	.2356	.0785	.310	.9739	.4870	.1623	.470	1.477	.7383	.2460
.160	.5027	.2514	.0838	.320	1.005	.5027	.1675	.480	1.508	.7540	.2513
.170	.5341	.2676	.0881	.330	1.037	.5184	.1728	.490	1.539	.7697	.2565
.180	.5655	.2828	.0943	.340	1.068	.5341	.1780	.500	1.571	.7854	.2617
.190	.5969	.2985	.0995	.350	1.100	.5498	.1832	.510	1.602	.8009	.2670
.200	.6283	.3142	.1047	.360	1.131	.5655	.1885	.520	1.634	.8168	.2722
.210	.6598	.3299	.1100	.370	1.162	.5811	.1937	.530	1.665	.8325	.2774
.220	.6912	.3456	.1152	.380	1.194	.5969	.1989	.540	1.696	.8482	.2827
.230	.7226	.3613	.1204	.390	1.225	.6126	.2042	.550	1.728	.8639	.2879
.240	.7540	.3770	.1257	.400	1.257	.6283	.2094	.560	1.759	.8796	.2931

INTERPOLATION TABLE.

Add'l wt.	Add'l k	Add'l m	Add'l c	Add'l wt.	Add'l k	Add'l m	Add'l c	Add'l wt.	Add'l k	Add'l m	Add'l c
.001	.0031	.0016	.0005	.004	.0126	.0063	.0021	.007	.0220	.0110	.0037
.002	.0063	.0031	.0010	.005	.0157	.0079	.0026	.008	.0251	.0126	.0042
.003	.0094	.0047	.0015	.006	.0188	.0094	.0031	.009	.0283	.0142	.0049

(For method of interpolation, see Data Sheet No. 129.)

DATA SHEET NO. 164, THE FOUNDRY, JUNE, 1914.

Note—This sheet may be cut into two sections, 8 x 7 inches, and may be readily bound in note-book form.

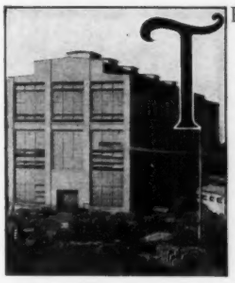
THE FOUNDRY DATA SHEET, JUNE, 1914

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Building a New Foundry Over Operating Shop

How This Work Was Accomplished by the Westinghouse Air Brake Co. Without Missing a Heat—Making Intricate Cores

By Ellsworth Tonkin



THE development of locomotives of constantly increasing weight and tractive power, together with growth in the length of trains and the weight and capacity of cars, has resulted in enlarged demands on the air brake apparatus necessitating the supply of a greater volume of compressed air than ever before. To meet this situation the Westinghouse Air Brake Co., Pittsburgh, has developed a new cross-compound locomotive type air compressor and other new devices for equipping trains. To make the parts for these large compressors, a new gray iron shop has been built at Wilmerding, Pa., known as Foundry No. 3, and in addition to the work mentioned, it takes care of the overflow from the two old foundries.

To obtain the required floor space within the limited ground area, the building was made two stories high and long and narrow. The second story is to be used as a molding floor in case there is a demand for more tonnage in the future. The experience of years in air brake work as well as the principles underlying the use of modern machinery, were considered and embodied in the plans for the new foundry. Fig. 1 shows how foundry No. 3 was erected over a shed which was used to take care of part of the overflow from the old shops during the construction period. The work in the improvised foundry was not interrupted and was continued in the new building when it was completed and the old structure removed.

Foundry No. 3 is a two-story brick building, 300 feet long and 54 feet wide. The steel columns which support the traveling crane and jib crane runways, together with the second floor and roof, are partly encased in 18 x 36-inch brick pilasters. Between the pilasters on each floor is a 13-inch brick wall capped by a concrete sill, 3 feet, 6 inches above the floor. Above the sill is solid steel window sash. Fig. 6 shows a section of the wall, sill and window sash completed up to the second floor. To make the molding room as light as possible, this construction is carried out between the columns all around the building except on the first floor, where there is a 10 x 10-foot sliding steel door in each end of the building, together with two 5 x 7-foot sliding steel doors and eight 12 x 7-foot openings between columns leading to the sand storage bins and cupola shed on the side of the building adjoining Foundry No. 2. The first floor is solid concrete and the second, which is 36 feet, 1 inch above the first, reinforced concrete.

FIG. 1—BUILDING A NEW FOUNDRY OVER AN OLD ONE

The concrete for the second floor was laid on false work. The finished floor is supported by 5-foot, 7-inch steel plate girders, 54 feet long, which extend over the first floor between the columns. There are ten 15-inch I-beams between each set of girders and columns. The construction of the roof is illustrated in Fig. 7. A thin layer of reinforced concrete was laid on a false roof, over which a single course of hollow tile, covered by a coating of asbestos roofing was placed. The roof is supported by the steel trusses shown in Figs. 9 and 10. The sides of the ventilators, and the partition between the molding floor and cleaning room are formed with cement plaster laid on steel lath. There are two stairways, 4 feet, 6 inches wide, located as indicated in Fig. 8, as well as two 5-ton electric elevators communicating with the second floor.

A Well Ventilated Shop

The first floor is ventilated by two rows of hinged steel sash placed at the top and bottom of the large windows. The sash may be operated individually from the floor. Six 10 x 15-foot ventilators, Fig. 9, extend through the second floor and to a sufficient height above the roof to have hinged sash on each side which are operated from the second floor. This floor is ventilated by hinged sash operated from the floor level, and by continuous sash on both sides of the monitor in the roof.

Both floors are heated by hot air which passes over steam pipes and through a 64-inch double outlet fan, driven by a 50-horsepower motor located on the second floor. The air is distributed by four large galvanized sheet steel pipes which run the full length of the building as shown in Fig. 8. The steam for the heating system is furnished from the blacksmith shop exhaust line; live steam may be obtained from the boiler house when the blacksmith shop is not in operation.

The molding and cleaning departments on the first floor are separated by a 10 x 10-foot double sliding steel

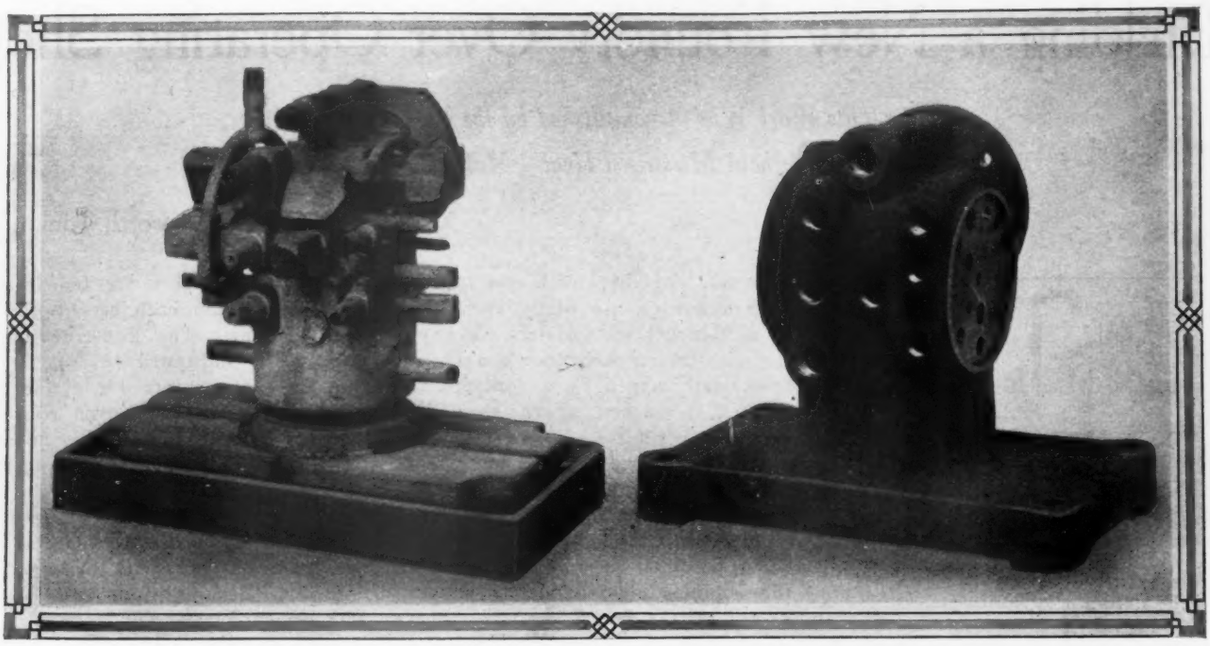


FIG. 2—INTRICATE CORE FOR UNIVERSAL THREE-FACE PIPE BRACKET TOGETHER WITH CASTING

door. A 9 x 10-foot double sliding steel door leads to the elevator from the cleaning room, as illustrated in the first floor plan, Fig. 8.

Core Department

The core department occupies one end of the first floor. Core oven No. 1 has two heating chambers, 4 feet, 6 inches wide, 10 feet long and 6 feet high with thin brick partition walls. Core oven No. 2 has four heating chambers, two of which are 4 feet, 6 inches wide, 5 feet long and 6 feet high for heavy cores baked on cars as in oven No. 1 and two are 12 feet, 6 inches long, 3 feet wide and 6 feet high. The latter chambers are provided with shelves at the sides for baking small cores. Thin brick walls also separate these chambers. Each chamber is provided with a gas burner with control valves on the outside for regulating the heat. Roller doors are used on the large chambers and steel plate doors are used on the side chambers. The latter are small so as to expose only part of one shelf when open. A sand dryer, core sand mixer, oil storage tank, portable gyrating sand sifter, portable core dryer, core benches and storage racks are conveniently arranged around the ovens. The core room is located temporarily on the first floor and will be moved to the second floor as the demand for floor space increases.

The foundry is equipped with two direct-draw, roll-over jolt machines with a capacity for flasks 54 inches long, 30 inches wide and 18 inches deep. The air for these machines and other parts of the foundry is supplied by two Westinghouse, 10½-inch cross-compound, locomotive type compressors. The apparatus for handling material includes a 5-ton traveling crane and two 2-ton jib cranes. The

FIG. 3—AIR BRAKE VALVE CASTING

hot metal is handled by the crane in one, two and five-ton ladles. Portable gyrating sand shifters are used in different parts of the foundry. The balance of the floor space will be devoted to machine molding.

Cleaning Room Equipment

The cleaning room is equipped with four 40 x 56-inch tumbling barrels belted to an overhead line shaft, driven by a 35-horsepower motor. The dust is collected and carried outside the building to a 300-unit vacuum collector which is large enough to take care of six tumbling barrels. The circulation of air through the tumbling barrels, collector and 17-inch pipe is maintained by a 45-inch cycloidal exhaust fan, direct-connected to a 6½-horsepower motor. The fan creates a vacuum of 3 ounces. Two Westinghouse double emery grinders, driven by 5-horsepower motors direct-connected to the wheels, are located between the tumbling barrels on one side of the cleaning room. They are used for dressing small castings as they are taken from the tumbling barrels. The castings are then loaded on industrial cars and taken to the stock yard or machine shop. The other side of the cleaning room is equipped with pneumatic tools and benches for chipping and cleaning the larger castings. Two 2-ton overhead cranes, Fig. 8, are used for handling the heavy work in this department.

The second floor which will eventually be used for a core room has two sectional, double, enclosed flame, gas-fired core ovens, each of which is provided with eight drawers, 2 feet, 9 inches wide, 5 feet, 6 inches long and of varying depth. The shelves run on ball-bearing rollers and when outside of the ovens are supported by a steel frame. The ovens are of steel construction and are lined with asbestos. The air for combustion is forced through the burners by a positive blower rated at 3.3 cubic feet per revolution. It is belt-driven from a six-horsepower motor. The products of

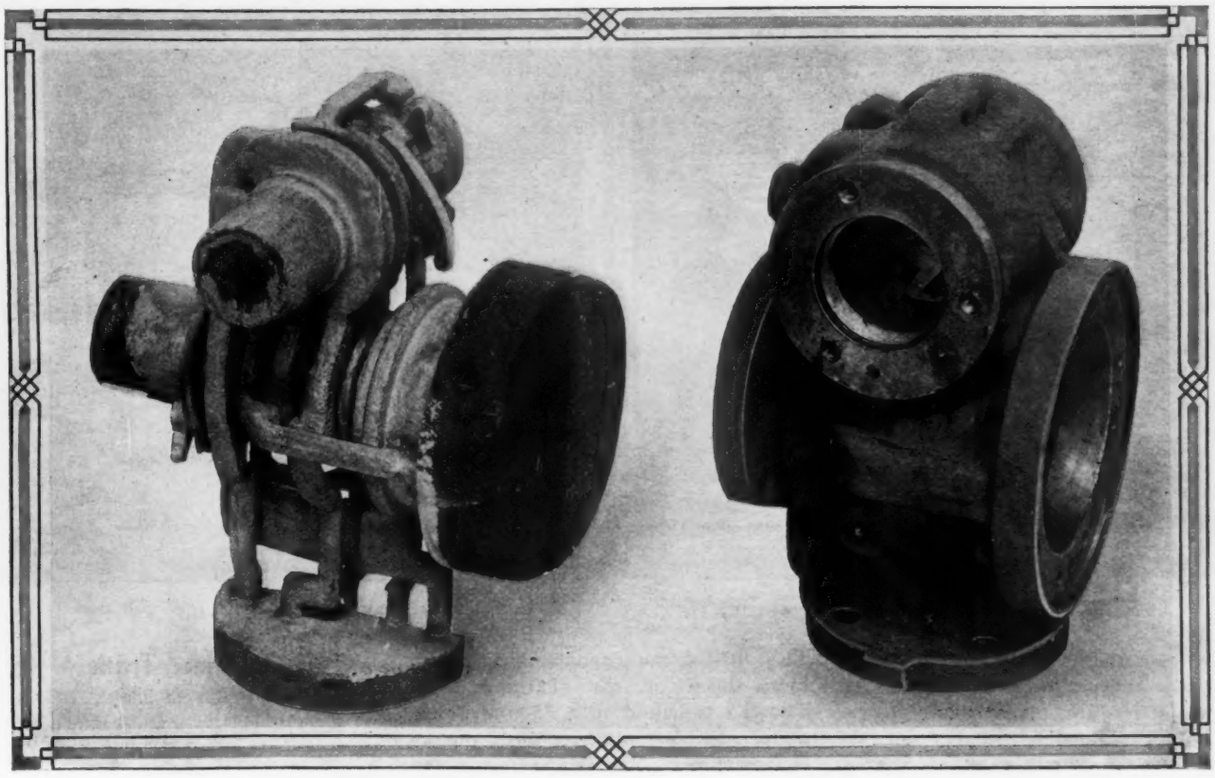


FIG. 4—CORES FOR UNIVERSAL T-VALVE AND CASTING

combustion are carried up through the roof to the atmosphere by piping connected to each compartment in the ovens. The heat is controlled by valves conveniently located at the side of the ovens. Core benches, storage rocks, a sand dryer, sand mixer and sand sifters are conveniently arranged around the oven. Other ovens will be added as the demand for cores increases. Cores, sand and other material will be transferred to and from this floor by two 5-ton elevators.

The necessity for so much core room space may be understood by studying the methods of making and assembling three of the many cores required for air brake work. Most of the cores are made from a mixture of 75 parts washed silica sand and one part raw linseed oil or a mixture of washed silica sand, loam and flour. The proportions of the latter mixtures depend on the size and shape of the core. An ordinary flour and water paste is used for pasting the cores together.

Cores consisting of two or more parts are made in several ways depending on their size and shape. All the parts may be made, pasted together and baked; or they may be made, baked, then pasted together and baked a second time; also one part may be made, baked, then covered green and baked again, or one part may be made of sand and oil mixture and another part of a sand, loam and flour mixture. In addition to the above, practically all the cores are wired. The wires are so placed that they may be conveniently pulled from the casting. A great many of the wires are removed while the castings are hot. When two cores are pasted together, the joint is always made

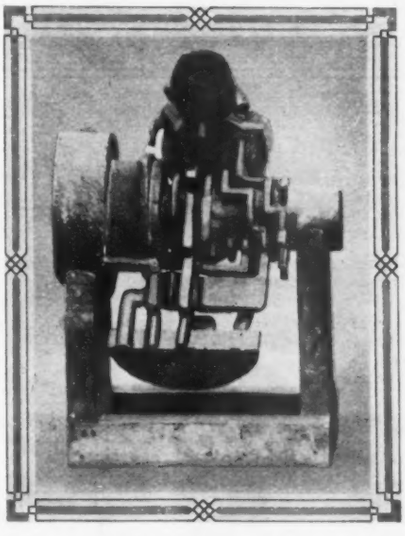


FIG. 5—CRADLE FOR TRANSFERRING CORE

where the fin can be knocked out through a core hole in the casting. The cores are vented as they are made, wax tapers seldom being used.

Fig. 11 illustrates the various cores for the universal valve, three-face pipe pattern. Cores *3* to *17* inclusive, are placed in prints in the drag and in prints in the cores themselves in the order of their numbers. The paste on the assembled core then is dried with a gas flame. The remaining cores are placed in the prints in the cope and fastened with nails except cores *24* and *25*, which are tied with wire. Core *17*, in the drag, is held in place with two cast iron anchors. Cores *16*, *17*, *20* and *25* are located in the mold by gages; the others are located by the prints in which they fit. Cores *1*, *2*, *4*, *5*, *6*, *7*, *12*, *14*, *18*, *20*, *21* and *23* are made in one piece each, and each of the others consists of two pieces except *11* and *17*, which are three-piece cores. At the left, Fig. 2, the complete core is shown. Cores *1*, *2*, *4*, *7*, *8*, *9*, *12*, *14* and *20* are not illustrated as they are supported either by the drag or cope.

Fig. 4 shows a core made from 28 sections. This core is assembled in different manner than that illustrated in Fig. 2 in that the two largest pieces are placed in jigs and the other parts assembled around them. After being assembled and baked, it is placed in a cradle, Fig. 5, in which it is transferred to the molding floor.

The sand storage bins are built in between foundries Nos. 2 and 3. They have brick walls which separate the bins and also support the standard railroad track leading to the cupola shed. The roof is of reinforced con-

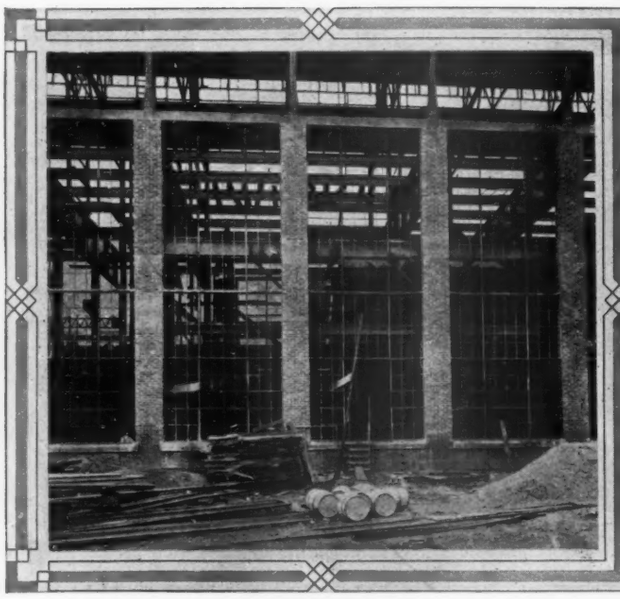


FIG. 6—THE WALLS ARE NEARLY ALL GLASS

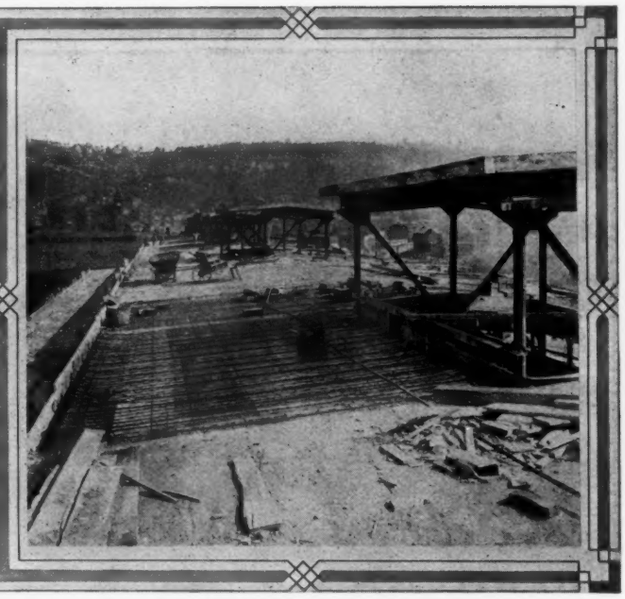


FIG. 7—CONCRETE AND TILE ROOF

crete construction, with I-beams placed directly under the rails of the track. Trap doors are placed between the rails for unloading sand from the cars into the storage bins. A 7 x 12-foot opening leads from each bin into foundry No. 3.

On account of limited space, the cupolas in the shed of foundry No. 2 have to be used for foundry No. 3 by running a hot metal trough to the molding floor of the new shop under the railroad track. The melting equipment includes two Colliau cupolas with a capacity of 14 tons per hour each. The air for the cupolas is furnished by a blast on the charging floor. The fan is belted to a 75-horsepower motor. A blast pressure of 12 ounces is maintained. The fuel, pig iron and scrap are delivered to the charging floor on standard railroad cars which are switched in on the track extending over the sand bins.

The coal and coking plant of the Wisconsin Steel Co., at Benham, Ky., is offering a cash prize of $250 to the employe keeping the best lawn during the coming summer.

A Welded Truck

By Arnold Torch

The steel truck made by the Standard Improved Truck Co., Chicago, is a striking example of the increased efficiency and decreased cost of manufacture by welding sheet steel articles, as compared with drilling and riveting. The truck previously was made by drilling and riveting all of the joints, but welding the different parts by the Oxweld process was proposed, and a test truck was made by this method. So successful was this process that it was adopt-

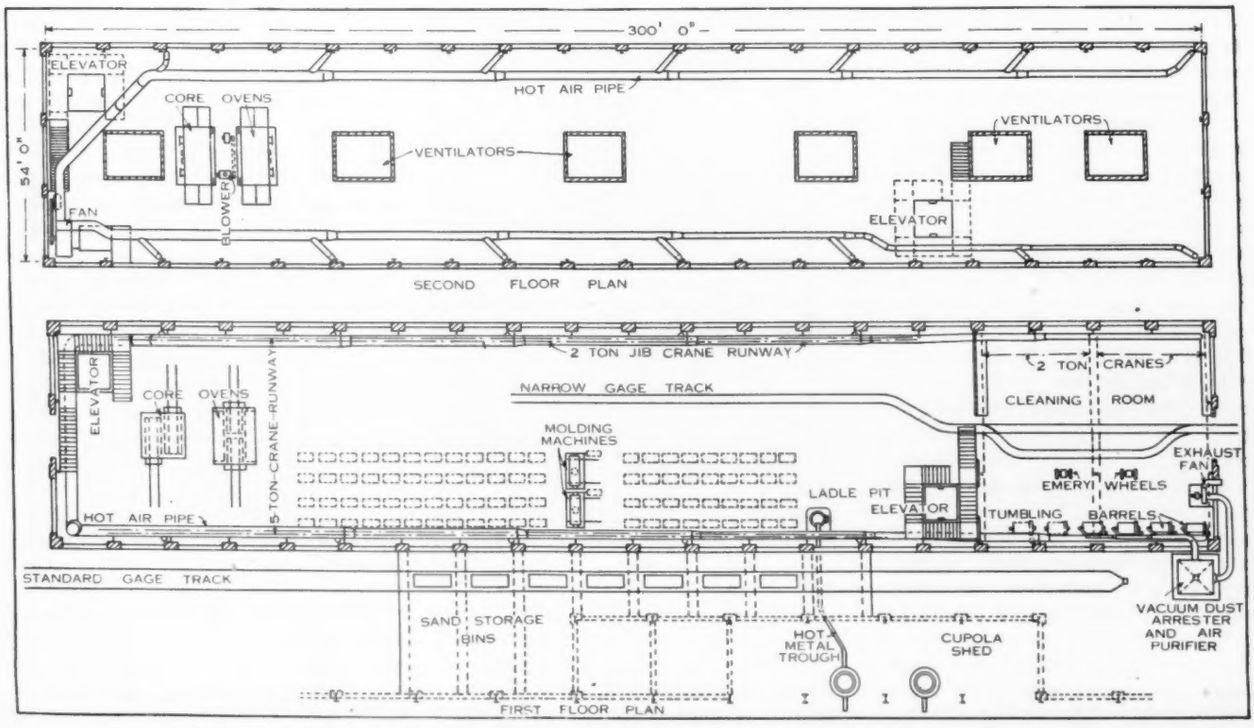


FIG. 8—PLAN OF FIRST AND SECOND FLOORS OF FOUNDRY NO. 3

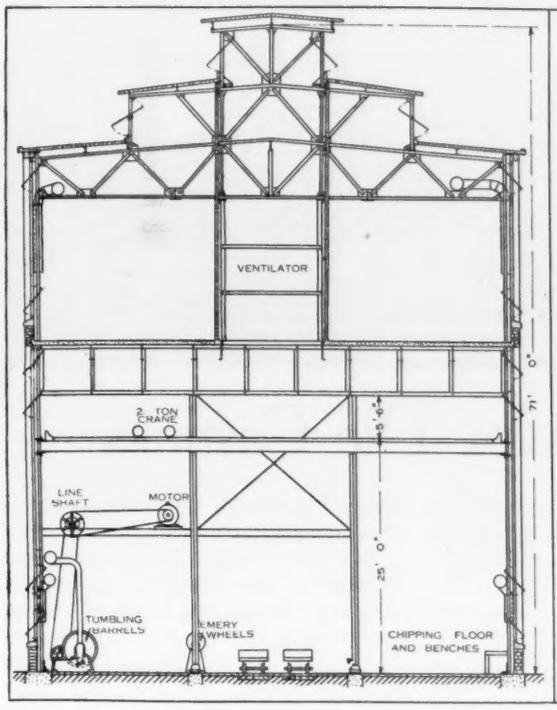


FIG. 9—SECTION THROUGH CLEANING ROOM

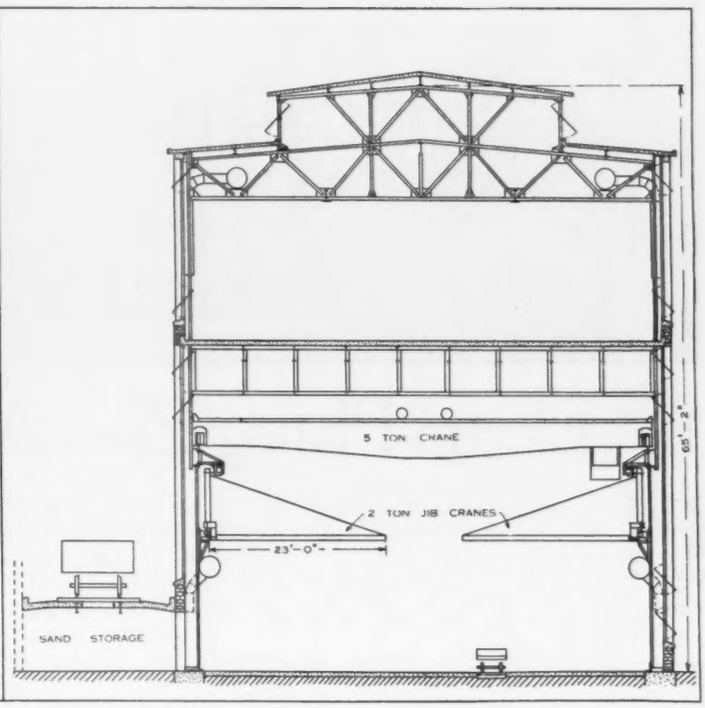


FIG. 10—SECTION THROUGH MOLDING ROOM

ed immediately and the riveting method was abandoned. By the welding process a one-piece truck was produced with an efficiency at the welds 482 per cent greater than riveted joints, and the output per man was increased 20 per cent with a saving of more than 30 per cent of the previous cost of manufacture per truck. Tests of the welds were made by Robert W. Hunt & Co., Chicago, and under a load of 17,090 pounds the cross tube on which the tension or pull was applied commenced to scale, indicating that the elastic limit of the steel in tension had been reached. Under a maximum load of 25,460 pounds the cross tube broke from the stringer tube at the weld. At 24,540 pounds a considerable reduction in the cross-section of the stringer pipe at the point of connection was noted, but there was no sign of rupture at the weld. This connection was welded by the oxy-acetylene torch.

A riveted connection with two ¼ inch rivets in double shear showed a slippage of 1-16 inch under a load of 2,920 pounds, due to the bending of the rivets and the loosening of the connection. Under a maximum load of 4,740 pounds the rivet in the stringer tube sheared off. Another riveted connection showed a slippage of 1-16 inch under a load of 3,060 pounds as a result of the bending of the rivet in the cross tube, and at 4,010 pounds the separation at point of connection was ½ inch. Under a maximum load of 5,800 pounds, the rivet in the cross tube sheared off and the rivet connection in the stringer tube pulled partially through the stringer tube. The welding outfit employed by the Standard Improved Truck Co. was furnished by the Oxweld Acetylene Co., Chicago.

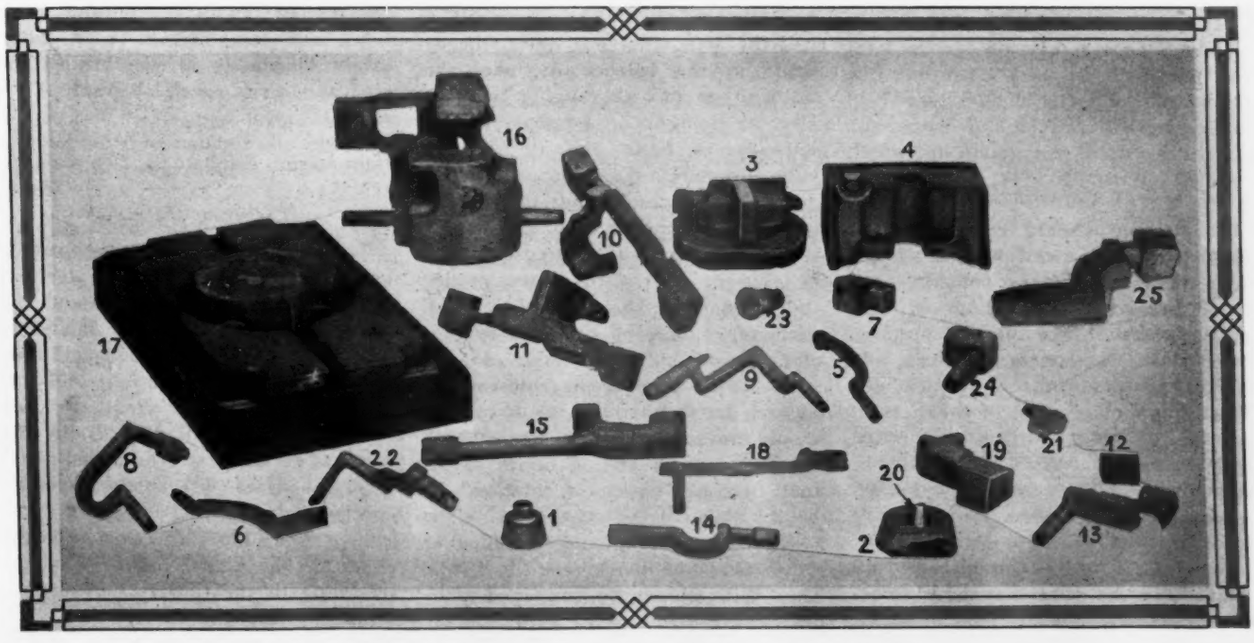


FIG. 11—LOOSE CORES FOR PIPE BRACKET SHOWN ASSEMBLED IN FIG. 2

Electro-Plating Zinc Alloy Die Castings

AN INTERESTING discussion of the method of electro-plating zinc alloy die castings is contained in a booklet recently issued by the National Lead Co., New York City. It is stated that die castings that are to have a polished surface should be cut down with the usual buff wheels and tripoli composition. The finishing should be accomplished with white compositions of Vienna lime. After the articles have been polished the excess of polishing material should be removed by the aid of benzine or gasoline and afterwards dried out in maple sawdust. If the benzine or gasoline is dispensed with then hot alkaline solutions should be used for cleansing. The strong alkalies of caustic soda or potassium should never be used in cleansing zinc, as they have a reducing action upon the metal and produce oxides; thus destroying the polished surface.

The cleaner should be maintained at a temperature of 160 to 180 degrees Fahr. Soda ash may also be used for the purpose. In such an event one pound of the material and quarter of an ounce of cyanide of potassium should be used per gallon of water.

Cleansing

The article should remain in the cleansing bath for a few minutes and then the excess of the polishing material brushed away, using an oval painter's sash brush for the purpose. After cleansing immerse in clean, cold water and then into a cyanide dip. This dip should consist of 6 ounces of cyanide of potassium or sodium to each gallon of water and should be used cold. After re-washing the articles in clean, cold water they are ready for the plating bath.

Articles to be unfinished are cleansed in the same manner if somewhat corroded due to the formation of oxide or zinc upon the surface caused by the contact with moisture. Immerse for a few seconds in a pickle consisting of one part hydrochloric acid and four parts of water. This will dissolve the oxide. Then rinse the die castings in cold water, immerse in the cleaning solution for a few seconds, re-wash in cold water and then scratch-brush to bring up the color of the metal. Repeat the cleaning operations using only the cleaning solution and the cyanide dip and the casting is ready for plating. If the articles are to be a polished finish then the scratch brushing may be dispensed with.

Copper Plating Die Castings

The solution for copper plating should consist of the following proportions:

Water	1 gallon
Cyanide of copper	3 ounces
Carbonate of potash	1 ounce
Cyanide of potassium or sodium	4 ounces

To prepare the solution the potash and copper should be dissolved in half the amount of hot water, the cyanide in the balance of luke-warm water; then mix thoroughly together. Use the solution at a temperature of 150 degrees Fahr. and at 2 to 2½ volts pressure. Cast copper anodes give the best results, but the electrolytic variety may be used.

To brass-plate die castings, prepare a solution exactly the same as the copper bath. Then dissolve equal parts of cyanide of zinc and cyanide of potassium in warm water. An addition of 1 ounce of the zinc carbonate and the same proportion of cyanide should be added to the copper bath per gallon; then add ½ ounce of sal ammoniac per gallon of solution. If the color should be too deep a yellow a little more zinc should be added to the bath to obtain the requisite shade. This bath should be run at a temperature of 120 degrees Fahr. and at a 2 or 3 volts pressure. The cleaning of the articles should be as previously stated.

Much trouble has been experienced in nickel plating die castings with the ordinary solution due to black streaks appearing in the deposit caused by local action of the ordinary solution upon the metal. The following formulas will give satisfactory results without the difficulties mentioned:

Nickel sulphate	10½ ounces
Potassium citrate	7 ounces
Ammonium chloride	10½ ounces
Water	2½ gallons

To prepare this bath dissolve the nickel sulphate and ammonium chloride in half the amount of hot water prescribed; then dissolve the potassium chlorate in the balance of the water and mix thoroughly. The voltage should be 2½ to 3 volts. This bath should always be kept neutral to avoid black streaks. For this purpose pure caustic potash should be used dissolved in water and added to the bath so that the solution is neutral to the test of red or blue litmus paper. The following bath is used extensively in plating articles made from zinc and gives excellent results:

Double nickel salts	8 ounces
Chloride of sodium	1 ounce
Magnesium sulphate	2 to 4 ounces
Water	1 gallon

Preparing the Bath

To prepare the bath dissolve the nickel salts in half of the water at a temperature of 180 degrees and dissolve the other salts in the balance of cold water; then mix thoroughly together. Use this solution cold and anodes of cast nickel should be used. The voltage should be 2½ to 3½ volts. The articles to be nickel-plated may be plated direct or previously lightly coated in the copper or brass baths. The time of immersion in either of the nickel baths should be according to the thickness of deposit required, although 30 minutes gives fairly good deposit in either case.

For silver-plating die castings the following solution is recommended:

Cyanide of silver..... 3 ounces
Cyanide of potassium..... 4 ounces
Water ..... 1 gallon

Use anodes of pure silver at about 1 volt pressure. Die castings for silver plating should be previously copper plated for a short time then amalgamated in a mercury dip consisting of the following proportions:

Water ..... 1 gallon
Oxide of mercury..... ½ ounce
Cyanide of potassium..... 6 ounces

After copper-plating and washing in water the articles are immersed in the dip for a second or two or until uniformly coated with mercury. They should then be re-washed and immersed in the silver bath. Or the articles may be nickel-plated in one or the other of the nickel baths and quickly coated in the silver striking solution and then directly immersed into the silver bath without rinsing in water. The silver strike should consist of the following:

Cyanide of silver..... ½ ounce
Cyanide of potassium..... 6 ounces
Water ..... 1 gallon

Use silver anodes with 3 to 4 volts pressure. The nickel surface must be immediately coated over for successful silver deposits.

Gilding Die Castings

In gilding die castings the articles must be previously coated with brass or copper and a bright lustre maintained upon the articles.

The following formula will give excellent results:

Phosphate of soda..... 8 ounces
Sulphate of soda.....1½ ounces
Cyanide of sodium....6 pennyweights
Chloride of gold.....6 pennyweights
Water ..... 1 gallon

To prepare the solution dissolve the cyanide and chloride of gold in part of the hot water and the sodium salts in the balance; then mix together thoroughly. Anodes of gold, platinum or carbon may be used and the bath should be kept at a temperature of 180 degrees Fahr. at 2 volts pressure. If the articles are previously coated in the copper bath they should afterwards be flashed in the brass bath to save an excess of gold.

The usual lacquers should be applied to brass, copper, silver or gold finishes. The various antique finishes may be applied to the articles after plating in the requisite solutions for the various finishes in vogue by using the various agents which most platers are familiar with.

In plating die castings or articles of zinc it is a distinct advantage to use as little free cyanide as possible. If this is reduced to a minimum very little difficulty will be experienced in the blistering of the deposit.

In nickel-plating the baths should be maintained at the neutral point, as previously noted.

DIFFICULTIES OF THE PLATER

The Reason Why and the Remedy

A Properly-Equipped Nickel Tank

Our nickel tanks are 10 feet long, 3 feet wide and 30 inches deep. An iron rod passes through the sides above the solution at the center of the tank, to prevent the sides from bulging outwardly, the rod having plates held by nuts on each end. This rod is a constant annoyance, especially when using holders for plating. We are now plating large quantities of brass tubing in 8-foot lengths and find the iron rod troublesome. Do you know of any practical method of keeping the tank in shape without the iron rod crossing the tank? This rod also supports the center rod of anodes.

Equip each tank in the following manner: For a 10-foot tank secure two iron rods, ⅝ inch in diameter and 10 feet 3 inches long and thread each end for a distance of 2 inches. Bore a ⅝-inch hole diagonally from the end through each side of tank and about 6 inches from the top so that the hole will allow the iron rod to be used as a truss rod on each side with the nuts on each end bearing against a washer on the end wood of the tank side. Place a 2-inch wooden block between the tank and rod at the center of the tank side and tighten the nuts alternately and you will find the iron rod you now use will become slack and may be removed, the tank retaining its shape without a cross brace. As the truss rods project but 2 inches from the tank at the sides it does not interfere with easy access to the tank and in time becomes unnoticed.

Supporting Block

The center rod of anodes then are supported by a ⅞-inch strip of wood attached to a block, 6 inches long and 2 inches wide. The block is placed at the bottom of the tank to prevent injury to the asphalt lining and the upper end of the strip is grooved to receive the center rod. This strip and block when fastened together are coated with asphalt. Small, grooved, wood blocks are made next and are coated with asphalt, being fastened to the sides of the tank at the inside center by ½-inch bolts. These blocks support the outside anode rods. If the cathode tube is so small as to bend under the weight of the work attached, it may be reinforced by an iron bar placed through it or by a hardwood strip, 1½ inches square and as long as the tank is wide, placed across the top of the tank with hooks inserted so as to engage the cathode tube when the heavy work is suspended.

Finishes for Brass

Our work consists of small brass parts for various electrical supply houses and a large portion of it is nickel-plated. We believe we should get a heavier nickel deposit than we do from our solution which is composed of the double nickel salts and we prefer a brighter deposit, one that would color easily. Our brass finishes are the oxidized and verde. We would like to hear of other finishes or combinations which would be suitable.

The ordinary double nickel salt solution should give you a very heavy deposit if you can permit the parts to remain in the bath for 45 minutes or one hour, but if you must obtain better results in less time, an addition must be made to your solution, or a special, high speed solution prepared. To cause your present solution to deposit faster add 2 ounces of common salt to each gallon and to obtain a bright, easily colored surface, also add 3 ounces of boracic acid to each gallon. Use all the nickel anodes of good quality it is possible to hang in the tank without touching each other. If you buy a special, rapid salt, select one of high metallic percentage which is operated very dense. Use the best anodes obtainable and plenty of them. Do not expect any nickel solution to remain in

good condition with a scant supply of anodes. They are the cheapest source of metallic supply for the bath and those of exceptional purity are more durable and efficient with high speed solutions, the best of these being practically self-sustaining. The brass finishes you are now using are those in popular favor and we would suggest that you confine your attempt to the improvement of these by utilizing a more varied number of shades or by using the bronze or brown tones in conjunction with gray and green shades. There are a few colors which we might suggest which can be used on brass surfaces, but they are cheap in appearance and would not enhance the value of your product.

Rust-Proofing Gray Iron

We manufacture gray iron grave markers and we would like to finish them so that they will be as nearly rust-proof as possible. We would much prefer a japan finish, but would also like to know what can be done in the way of plating them.

Rust-proofing gray iron for such purposes as grave markers is indeed a problem when cost of treatment is a factor to be considered. As you prefer a japan finish, we would suggest that you test the corrosion-resisting properties of "bitumastic" coatings. These products comprise an enamel, a solution and a cement, each being particularly adapted to certain uses. The enamel would no doubt give you perfect satisfaction, if not too expensive, while the solution will prove greatly superior to the best japan finish if two or three coats are applied. It dries in 24 hours and is unaffected by the elements even after years of exposure. It does not crack or peel when alternately wet or dry. Its covering power is about 400 square feet per gallon and the cost is $1.50. The base of the solution is bitumen. The writer has used this material for the protection of iron work and has found it highly satisfactory even when the iron object has been subjected to the most severe tests during extremely wet seasons followed by cold and hot weather. These products may be obtained from Hill & Hubbell, 805 Superior avenue N. E., Cleveland. By purchasing the solution in barrel lots and using it as a dip for coating the markers, they could be treated cheaply. Ordinary japan, even with several coatings, furnishes an inferior protection to gray iron exposed to moisture.

The markers may be coated by electro-plating with either copper or both copper and zinc, but we believe the cost would be prohibitive. If really durable results were obtained, for example, the marker might be copper-plated from two to three hours in a sulphate copper solution containing free sulphuric acid. This process would necessitate first coppering the parts in a cyanide copper bath, as the sulphate solution attacks iron and the final copper deposit would have to be heavy. The raised portions, such as letters, etc., then would require polishing to produce a smooth surface, after which the piece could be given a black coating with either japan, celluloid, enamel or by oxidizing and then lacquering with a suitable heavy lacquer. If the castings were galvanized before japanning, the results would be more lasting than simply japanning and the treatment need not be expensive. The gray iron may also be treated by one of the several processes now in general use for rust-proofing iron, after which one or two coatings of japan could be applied. These rust-proofing methods are nearly all patented, but in order to give you a suggestion, we will mention one patented by a Mr. Richards, of Coventry, Eng., which is composed of 120 gallons of water, 3 pounds of manganese-dioxide and ½ pound of concentrated phosphoric acid. The solution is heated to the boiling point and the iron, previously having been cleaned, is immersed in the solution for from ½ to 1½ hours, then removed, dried by wiping and oiled or japanned. Another method of rust-proofing, which, as far as we know, is public property, consists of boiling the iron in a solution of concentrated phosphoric acid, 4 fluid ounces; fine iron filings, 1 ounce by weight, and water, 1 gallon. The filings must be from low carbon steel or wrought iron. The articles are immersed for from ½ to 1½ hours, then removed and dried without rinsing and either oiled or japanned.

Copper or zinc or a combination of the two metals deposited separately are the only coatings practical for your purpose, which could be applied by electro-plating, and as you favor the japan finish, we believe you will obtain excellent satisfaction by either the application of "bitumastic" coatings or by galvanizing previous to japanning, which should consist of two or more coats. Zinc is regarded as the best metallic coating for protection to iron and it is without a doubt the cheapest. It can be applied either by dipping the dry iron into the molten zinc or by electro-plating. With any coating such as japan, enamel or an ordinary metallic deposit, the greatest danger lies in the rough handling the article usually receives prior to being used for the purpose intended. An apparently insignificant spot or pit, a small bruise or indentation usually will become the nesting place of a multitude of minute particles of rust, and as "rust begets rust", the total destruction of the iron surrounding the spot is but a matter of time. All goods coated for protection from rust should be carefully guarded from rough handling in order to preserve a perfectly non-porous surface.

Cause of Spotted Finishes

We copper-plate a number of large sheet steel plates used as a background for porcelain letters. The surface is required rough or matte. We have plated several in good condition, but now the deposit is too smooth and glossy in spots. In other respects, the deposits appear to be satisfactory. The solution registers 22 degrees on the hydrometer and we use from ¾ to 1½ volts pressure.

Remove sufficient solution so that when it is diluted to 15 or 16 degrees Beaume, enough is contained in a fibre pail to plate a small piece of steel. Try this portion with the same current as usual and if the deposit is satisfactory, dilute the solution in the tank the same way. If, however, spots still form, add from ¼ to ½ ounce of C. P. sulphuric acid to each gallon, then test again. Should the trouble still exist, take a fresh quantity from the bath, dilute as before, then add from 1 to 2 ounces of carbonate of copper to each gallon, then test again. Bright spots usually are the result of one of these three conditions and may be corrected by the foregoing changes.

The Stow Manufacturing Co., Binghamton, N. Y., has issued a circular describing a two-spindle drill which has a capacity for drills up to ½ inch in diameter, operating at a speed of 450 revolutions per minute. The larger size of this tool will take drills up to ¾ inch inclusive, and operates at a speed of 225 revolutions per minute.

The American Emery Wheel Works, Providence, R. I., is sending to the trade a chart which clearly points out the principal causes of grinding wheel accidents and contains suggestions of how they may be avoided. Copies of these charts can be obtained from the American Emery Wheel Works upon application.

A Wonderful Tropenas Converter Heat Record

How Twenty-three Blows Were Made in Eight Hours
With an Average of Six Minutes Between Blows

By Enquirer

THE foundry with which I am connected recently made 23 blows in a one-ton Tropenas converter from 9:20 a. m. to 5:40 p. m. The blast was put on the cupola at 8:30 a. m. and the first blow was started in the converter at 9:20 a. m. I would like to know if any foundry can show a better record than this in number of heats in the same time with similar equipment. The converter lining at the start of this run was not new, as on the previous day we had taken off 13 heats and patched the converter the morning we made the big run.

Prior to our big run we had, at various times, made 13 and 14 blows, but we have always considered that 10 blows, day in and day out, are as good an average as we could well hope to maintain, and that has been, in a way, our standard.

Early last fall, however, we were up against the power problem. We buy our current from the traction company on the off-peak principle. During the summer we had no trouble, as the peak came during the evening, but as the days grew shorter the time during which we had power grew shorter too. It was, of course, very much to our advantage to keep on the off-peak service if possible. The obvious thing was to cut down our blowing time, and, as we had, up to this time, taken our steel directly from the converter in shanks, we decided to try pouring the whole blow into a ladle and shanking from that. This cut our time between blows from 20 to six minutes, and enabled us to average about three blows an hour instead of a blow every 35 or 40 minutes.

Difficulties Overcome

To those familiar with two-ton converters, this seems so simple a solution as to be ridiculous, for it is standard practice almost everywhere, but in the case of a one-ton converter there is not a large enough body of metal to keep perfectly fluid during the double pouring process. We anticipated trouble with cold metal, but we did not anticipate the effect on the converter, due to the constantly maintained high temperature of practically continual blowing. We could get our temperature by judicious addition of ferro-silicon, but lost the good effect of this addition through excessive wear on the tuyeres and bottom. This latter trouble was entirely new in our blowing experience, for, as most converter operators will testify, great difficulty usually is experienced in keeping the bottom and parts of the converter below the tuyeres, from building-up. But with us, each blow was larger instead of smaller, and the constantly changing level of metal during the blow gave us no little trouble. However, we had to find a way out, and at last found a perfectly satisfactory ganister lining mixture.

We are now able not only to pour our ladle clean every blow, but to keep our spills and skulls within a satisfactory limit.

There is a big proposition in that last sentence, for while it is comparatively easy to pour the ladle clean, it is a different proposition to have the last two or three pots hot enough to be of use for castings. This is especially true in a shop running so strongly towards light work as our foundry.

Night Gang Eliminated

In ordinary practice, we put the wind on the cupola from 9:30 to 10:30 a. m., and get our 10 blows out of the way safely before four o'clock in the afternoon. This works the double economy of allowing us to keep the off-peak power service and to do away with a night gang to shake-out and clean up the floors. The latter operation is satisfactorily performed by the day laborers, after pouring and before quitting time.

We also found that we did not need to knock out the bottom of the converter more than twice a week. Our lining mixture stood up so well on the tuyeres that by running the blower at slow speed about three hours during the night, the repair man could get inside in the morning and, without great discomfort, do any small patching that was needed, sometimes building the tuyeres up on sticks to the required length.

We found it safe to run four days in this way and could doubtless make it go for a week, but the building-up process mentioned makes the blows so small that a longer run is impractical.

Then came the chance to test the *system*. We put in a new converter Wednesday, May 3, that is, a new bottom, tuyeres, back side, and a good substantial patch and ran off 13 blows, cleaning the floor. Thursday we did not blow. The converter lining was in such good shape that, under ordinary circumstances, we would not have considered knocking-out the bottom. But, knowing that a big run was probable Friday, we looked the situation over pretty carefully. The vital point was, of course, the tuyeres, and they were hardly burned away at all. So we left the bottom in.

Ready Early in the Morning

A night man patched-out the cupola, put in the coke bed and first five charges, so that at 7 a. m. everything was ready for the start. It was 8:30, however, before we put on the wind, as we wanted to thoroughly dry our patch in the converter before putting in our gas heater. The iron melted quickly and was very hot, so we started the first blow at 9:20, hoping for 18 blows.

By a combination of circumstances, we had a big floor of medium heavy work, and the blows were not overly large, finishing at about 1,650 pounds, so our 18 blows were stretched to 20 then 22, and at 5:40 we turned down the 23rd blow.

The nose of the converter was burned out almost to the shell, but the tuyeres, back side and lower lining, looked good enough for an indefinite number of heats.

Osborn Mfg. Co. Expands

The Colonial works of the Osborn Mfg. Co., Milwaukee, has been removed from Florida street to South Water and Ferry streets, where a four-story building containing approximately 36,000 square feet of floor space is now occupied by the Osborn company. This plant is devoted exclusively to the manufacture of brushes and brooms and a large stock of foundry supplies also is carried at this branch. The new location is in the immediate vicinity of all freight depots and boat docks and is within a few blocks of the center of the city. The Osborn company is now in better position than heretofore to make prompt shipments to the trade throughout the Milwaukee district.

Report of Proceedings, Papers Read and D

THE annual conference of the British Foundrymen's Association was held May 12, 13 and 14, at Leicester, Eng. This was the first visit of the organization to this fine, old historical centre, and was chosen partly as a compliment to Councilor Sidney A. Gimson, the president, who with the aid of a strong local committee had arranged an admirable program of meetings, visits and entertainments. The central location of the town no doubt was partly accountable for the excellent attendance. About 70 members were present at the opening session. Leicester, as Americans probably are aware, is a great boot-making centre, but also has a fairly comprehensive group of miscellaneous trades, and includes some very large engineering establishments, while the Derby works of the Midland Railway Co. and the electrical works of the British Thomson Houston Co., at Rugby, are both within easy reach of the town.

Leicester has figured prominently in English history since the times of the early Britons, and the Romans made it one of their great centres. Probably, no town played a more important part during the feudal period, and on three occasions in the 15th century there were parliamentary assemblies at this Midland centre. The signs of its medieval character are to be met with in all directions, in remnants of old pavements, abbeys, churches, arches and quaint buildings which meet one at every turn, while the local museum contains a large number of interesting, ancient relics. The foundrymen, during the few moments left from their official and recreative program, found plenty to interest them, in inspecting these ancient memorials.

The meetings took place in the Technical school, a substantial building provided in the ancient part of the city called Newarke. At the time of the meeting a large number of students were at work in different departments.

SIDNEY A. GIMSON,
Re-Elected President, British Foundrymen's Association

The genial president, Mr. Gimson, is exceedingly popular, and received a cordial reception on rising to welcome the visitors. He expressed his satisfaction at seeing such a large attendance, and took this, the earliest opportunity of congratulating Dr. T. Swinden, of Sheffield on being awarded the Carnegie gold medal by the Iron and Steel Institute.

The report of the council recorded excellent work by all the branches, with a total membership of 974 against 923 the previous year, considered a very satisfactory increase. The special committee on apprentice training reported the collection of much useful information as a preliminary to formulating definite suggestions in the near future.

Mr. Gimson was enthusiastically re-elected president. W. Mayer and J. Ellis were re-elected vice presidents; F. W. Finch was re-elected treasurer and E. A. Pilkington was again unanimous choice for secretary.

The following five retiring members of the council were re-elected: W. H. Hatfield, G. B. Henderson, J. McFarlane, J. Oswald and J. Smith.

The address by President Gimson follows in part:

"First, I offer you a very hearty welcome to this old, but healthy and growing town. It is not a great engineering centre like the other towns and cities where our conferences have been held; still important engineering work is being carried out here, as you will find out during the conference, and no engineering of any consequence can go on without the help of foundrymen. We pride ourselves on our industry being a very ancient one; Leicester, too, is ancient—in fact, one

Discussions at Their Annual Conference

By J Horton, Staff Correspondent

of the oldest towns in Great Britain. "In some ways it seems an impertinence that I, no longer actively engaged as a founder, should address you as your president. While I have had many years in the trade, I still take a keen interest in it, and there may be something in the old saying, that, 'Onlookers see most of the game.'

"I am satisfied that no industry can be in a truly healthy condition unless it interests and elevates all the workers engaged in it. No quantity or quality of product can make up for deterioration of the human beings engaged. Architecture reached its highest development and gave us the grandest buildings when every builder was keenly interested and imbued with a knowledge and love of his art. We need variety and power of self-expression in our work—to be too mechanical is to deaden our souls. I am saying this because I see a certain danger in the great development of machine and other repetition work which is now with us and which must increase vastly in the near future. I don't wish to discourage machine work; I believe it is of enormous value and that every foundry must use it to its full extent. We cannot stop machine invention, and we do not want to. Cheapness of production is not only forced on us by competition, but is in itself a general advantage so long as the quality of the castings is maintained and improved.

"But work on the same job, week after week and month after month, is deadly dull, and may let the mind weaken for lack of exercise. Businesses which recognize this, which know that they need live men in their employment, all of them, men alive in mind as well as body, keen in their work and quick to see and suggest improvements of machines or methods, such businesses will deserve and secure success. Some variety in the work to be done is essential; moving from one machine to another or from one process to another. Above all things, I think we want to be sure that when boys are being trained in a foundry they do not get fixed too long on repetition work. They should have a thorough training in as many of all the foundry processes as the organization of the works will permit. And the organization should be such that a wide training can be given. The better training we give to the apprentices the less grumbling we shall hear about the scarcity of first rate molders.

E. A. PILKINGTON,
Re-Elected Secretary, British Foundrymen's Association

"As I said last year, I believe that the foundry industry is full of interest, an interest which reacts on the men engaged in it and makes them good workers, good citizens and good companions. But there are corners of the trade where there are dangers of this interest dying out. Like other trades we pass through the usual stages of evolution and reach the stage of machine work. I am hoping that we may learn wisdom from noting the drawbacks that have shown themselves elsewhere, that we may make full, legitimate use of machines and at the same time lessen, so far as may be, the disadvantages that may arise for those who work them."

The meeting then proceeded to the reading of papers, the first considered being by R. Buchanan entitled "Annealed Castings for Textile Machine Spindles." The paper was well illustrated by a fine series of micrographs, and the author exhibited also a number of interesting samples.

A brief discussion followed, in which H. P. Mason attributed the hard skin referred to, to the influence of sulphur dioxide. The great object in preventing that hard skin was to keep down the sulphur dioxide. F. J. Cook said he was interested in this class of work, although his

castings were much heavier, generally running up to 1,400 pounds. They occasionally got hard on the corners, and had to be annealed in a gas coke fire. While they were generally softened, occasionally they were hardened.

In replying to this discussion, Mr. Buchanan said that hardness from annealing undoubtedly was due to a sulphurous flame, and the best way to avoid trouble of that kind was to anneal in a closed oven, where the heat passes through the walls and excludes the flame. He did not believe in high temperatures for annealing, but he was a great believer in giving the proper time. A question had been asked about re-annealing, as a means of getting rid of hardness. He had only once come across a case where a hard skin had been remedied by re-annealing, and that was done by packing well with new borings, which enabled some of the sulphur to be absorbed.

Silica Sand Cores

The last paper read during the session was presented by F. Pulsford, entitled "Cores, with Special Reference to the Use of Silica Sand." The author exhibited some fine samples of intricate cores made with silica sand mixed with oil. In response to a question from Mr. Carrick, who said he was in the dark as to the mixture of oil and sand, the author said he mixed with one portion of Beeston sand, two portions of returned sand and one portion of Bedford sand, the latter being much the finest in grain. Cold drawn cod oil was used. Experience would show how much oil was necessary to give a proper bond, and it was found possible to mix the oil with water.

F. J. Cook said that the question of the use of oil was far from being a new one, and it had been used for a long time. The practice of emulsifying oil and water was also often followed. The most successful mixture he had tried for making cores for large castings was six of water to one of oil.

Mr. Carrick said he had used oil sand cores in America 15 years ago. He was working in the shop of a very large American firm when the Moseley commission from Great Britain visited America, and he met Mr. Maddison, who represented the molders, and that gentleman told him that one of the things that struck him most was the tremendous use made of oil cores.

F. Penlington asked for information regarding the cost of ordinary sand as compared with oil sand. Mr. Pulsford, replying to the various questions, said that it was useless to mill the sand because they did not want to break up the particles. The great necessity was to rub every little grain so as to be sure that it was surrounded by a particle of emulsified oil. He believed he wrote an article, three years before Mr. Carrick's appeared, and he gave a number of compositions for sand oil mixtures. Mr. Pulsford said he looked upon the United States as the home of the oil sand business. Over there, turning out such cores was like making hot cross buns. They did it without any trouble, because it was their business, and they had settled down to it many years ago. In England they were only like children at it, and did not half appreciate the numerous advantages of such cores, from every point of view. He never pretended that sand cores were new; but what he wished to make clear was that things were going on around them which they were not using. With regard to getting the cores out of the boxes, he found it an excellent plan to clean them with paraffin. If that was done every night, the box would be ready to work in the morning. With regard to relative cost he was unable to give exact data. Formerly, they used to pay 7½d for a core, and they had reduced the cost by more than 100 per cent. There was no question whatever as to the economy to be effected by the adoption of that system.

In the afternoon, a large party journeyed by train to Rugby to visit the works of the British Thomson-Houston Co. In the evening there was a reception by the Mayor and Mayoress of Leicester.

Second Day's Proceedings

As usual on the second day, the time was wholly devoted to the reading and discussion of papers. E. L. Rhead, of the Manchester School of Technology, read a paper on "Some Considerations on the Design and Working of the Foundry Cupola."

An animated discussion followed. R. T. Rolfe criticised the tuyere area given in the paper as affecting the admission of oxygen. It was essential to admit plenty of oxygen to get rid of the carbon dioxide.

F. J. Cook said the paper was a very practical one, especially as coming from a scientific man. The height of the cupola had a great effect upon economy, because if it was sufficiently high above the tuyeres, the charge has a chance to absorb the heat. With regard to blast pressure, he believed that increased blast would increase hardness. Other things being equal, the higher the blast the greater would be the hardness. He believed in a straight shaft cupola as giving the best results, being the most economical and requiring less fuel. He considered that to enlarge the tuyere towards the centre of the cupola was a wrong idea. Blast velocity was very important to secure a proper penetration of the material. He agreed that there was not much to be obtained with two or more rows of tuyeres.

J. Smith said he thought very little progress was being made in the design of cupolas. He had built a furnace for high-class work from a design over 100 years old, and it had worked perfectly, melting eight tons per hour with a blast pressure of 12 ounces.

Foundry Yields

In the absence of Mr. Longmuir and W. H. Robinson a short paper entitled "A Note on Foundry Yields," prepared by these authors was read by F. J. Cook.

Mr. Cook said that he was quite in agreement with the paper, which was given with a view to foundrymen holding inquests on their scrap castings. Probably they learnt more from one bad casting, if it was properly dissected and examined, than from 20 good ones.

Mr. Buchanan called attention to the difference between the wasters when an engineering firm was supplying iron to its own department, and when they were selling to the general public. Some firms were just as particular with the work going through their own foundries to the machine shop as with stuff they were selling to the public. But as a rule, where they were not selling castings, they were disposed to pass material which would be rejected by an outside buyer. That ought to be considered in any comparison of wasters.

Andrew Harley said he thought too much emphasis had been laid upon the inquest on bad castings. He believed it was much more profitable to study the good ones. When he got an extra good casting, he studied it carefully to find why he had produced it. He considered that the personal element entered into foundry work probably more than any other trade. The greatest reduction in the percentage of defective castings would come through design. He had succeeded in getting a voice in that matter, and so was not obliged to receive designs from which the

cleverest man in Christendom could not make good castings. It was also very important to have somebody in the foundry who understood a drawing.

C. Heggie read a paper on "Plaster of Paris in Foundry Work," and replied to many questions dealing with points of detail.

Mr. Riddell said he had had a great deal to do with plaster work, but asked what allowance was made for shrinkage and he wanted to know whether the addition of lime had any effect on shrinkage. He believed it practically eliminated it. He had found it very useful to make light molds of tin, and solder them together.

J. Simkiss said Mr. Heggie had rather revived an old industry, and the bedstead manufacturers of Birmingham had annually run many tons of plaster molds continually during the past 30 years. In Manchester they had found it necessary to carefully select their molders for this class of work. His own experience was that if it saved in the pattern shop it was more expensive in the foundry, and he rather thought that Mr. Heggie had brought it forward from an artistic point of view. He knew one case where the use of plaster had enabled a pattern to be made in six hours that formerly took three days.

Mr. Gordon wanted to know if Mr. Heggie had anything to do with the jelly mold which was very useful for repetition work. He had also found wire netting useful for strengthening a pattern.

Mr. Heggie, replying, said he was familiar with the jelly mold, but he considered the plaster better for such purposes. The wire netting he considered of no use where strength was required. It was true that lime is useful for reducing expansion, while no allowance was made for shrinkage.

The afternoon was spent in a visit to the works of the Midland Railway Co., at Derby, and in visiting various Leicester foundries. A smoking concert took place in the evening at the Grand Hotel, and the Leicester visit concluded on Thursday with a drive round Charnwood Forest, a visit being made to Cropstone reservoir and pumping station.

Preparations for Foundrymen's Convention

THAT the exhibition of foundry equipment and supplies, to be held in the International Amphitheater, Chicago, Sept. 5 to 12, concurrent with the annual meetings of the allied foundrymen's associations, promises to cover as much floor space as the show last year, is indicated by the large number of applications for space already filed with C. E. Hoyt, secretary of the Foundry & Machine Exhibition Co. The exhibition hall will be thrown open to visitors on Saturday, Sept. 5, and the show will close the following Saturday night. Preparations already are being made to handle the large tonnage of machinery to be installed and the equipment will be handled with the same facility as last year.

During the week of Sept. 7 the annual meetings of the American Foundrymen's Association, Institute of Metals and Associated Foundry Foremen will be held in Chicago. On Tuesday morning a joint meeting of the three organizations will be held at the La Salle hotel, followed by individual sessions at this hotel and the Stock Yards Inn, which adjoins the International Amphitheater, where the exhibition will be held.

An excellent program already has been outlined by the American Foundrymen's Association and the Institute of Metals and a large number of papers have been promised. To enable the members of the American Foundrymen's Association to attend the sessions in which they are directly interested, separate meetings will be held for the presentation of papers on gray iron, steel and malleable iron. A feature of the convention will be the Cost Congress, which should prove of the greatest value and interest to all foundrymen. Questions relating to the cost and selling prices of all classes of castings will be presented for consideration and an effort will be made to point out to foundrymen the necessity of knowing their costs before they can intelligently bid on work.

The American Institute of Metals likewise is outlining an interesting program replete with topics of practical value to melters of non-ferrous metals and alloys.

The entertainment features, in the hands of the Chicago local committee, will reflect the wholesome hospitality of the Windy City, and in addition to the many educational advantages offered by the meetings of the three technical societies and the exhibition of foundry equipment and supplies, ample opportunity will be provided for sight-seeing.

New Plant for Oven Equipment Co.

The new buildings now being erected by the Aberthaw Construction Co., Boston, at New Haven, for the Highwood Co. and the Oven Equipment & Mfg. Co., are making rapid progress. The plans call for the erection ultimately of a large head building along the railroad track, more than 400 feet in length, with several buildings at right angles to this and separated from each other and from the present Oven Equipment building by generous courts. The present construction includes the head building, one of the "parallels", the power house and the garage, of which the head building is well along towards completion and the others under way. Two elements which are expected to make a decided financial advantage for the owners of the new buildings are, first, the fact that all the sand necessary for concrete work was dug out of the cellars; and second, the fact that a large portion of the work, including all the form work, is being carried on under a bonus system which is working out to very good advantage. As the buildings are being erected on a cost-plus-profit basis, full advantage accrues to the owners from every gain of this sort which is made.

The Lumen Bearing Co., Buffalo, has issued a booklet entitled "Bronze Alloys and Babbitts", which describes bronze, brass and aluminum alloys made by this company for various requirements. The data included cover physical tests of bars both chilled and sand cast, and in addition Brinnel hardness results are included. The physical tests on both chilled and sand cast bars are among the first that have been given for these various alloys and should prove of value to all users of non-ferrous metals.

The Buffalo Foundry & Machine Co., Buffalo, announces that it has terminated its selling arrangements with H. E. Jacoby, who has been representing this company in New York City and vicinity, and hereafter all inquiries covering vacuum apparatus, castings, patterns and machine work from this territory will be handled direct from the home office of the company at Buffalo.

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Trade Outlook

SO GREAT are the resources of our country that expansion takes place during periods of greatly curtailed consumption. Statistics tell us that every trade depression is followed by an era of prosperity unparalleled in the annals of this great manufacturing nation and there is every indication that we are about to be launched into a market of such great activity that the output of the plants will be severely strained to meet the requirements. Stocks of metal products in the hands of both producers and consumers are at the vanishing point and with a bumper crop predicted, it is difficult to forecast any calamity that will check a tremendous buying movement. Fortunately, the present legislative debauch, whose watchword has been "Swat the Business Man", is nearing an end and it is to be hoped that the manufacturer soon will enjoy a period of rest from this legislative uncertainty that has threatened every business institution. Although the melt in practically all foundries is still below normal, the consumption of pig iron and non-ferrous metals for casting purposes is still sufficiently high to mark this one of the average years. Pig iron buying, notably on the part of steel shops, has been heavy and stocks in producers' yards are sufficiently low to occasion no alarm. In the leading centers, pig iron prices remain practically unchanged, as follows: No. 2, Pittsburgh, $14.15; Cleveland, $14.25; Ironton, O., $13.25; Chicago, northern, $14.25; 2X, Philadelphia and New York, $14.75; No. 2 plain, Buffalo, $13.75, and southern, Birmingham, $10.50. Basic is quoted at $13.90, Pittsburgh; Lake Superior charcoal at $15.75, Chicago, and $16, Buffalo, while malleable is held at $14.25, Chicago, and $13, Buffalo.

Foundry Accidents

WHILE it is generally believed by foundrymen that molders suffer more from burns than from any other form of accidents, statistics compiled by the International Molders' Union do not bear out this contention. During the past year 1,146 members of this organization suffered from burns sufficiently serious to keep them from work for more than one week, while 1,864 were the victims of other accidents which kept them confined for a similar period. That the union is imbued with the "Safety First" idea is indicated by the following from the *International Molders' Journal*: "The number of serious accidents and burns are both too high, and our members should be diligent in calling the foreman's attention to any condition in the foundry which should be changed in order to provide for greater safety." During 1913 the International Molders' Union paid 32,265 weeks sick benefits to 12,153 members, less than an average of three weeks each. Of the 12,153 members thus aided only 254 were afflicted with tuberculosis, a surprisingly small number, while 2,146 members were sufferers from other ailments of the throat and lungs. The foregoing figures indicate that the foundry is not a good breeding place for the white plague and that the arduous labor of the molder is not without its compensating features.

New Equipment for the Foundry and Pattern Shop

Vertical Draw Molding Machine—Ideal Core Sand Mixer—Air Compressor—Auto Sand Mixer—Adjustable Clamp—Bench Grinder

A VERTICAL draw molding machine embodying some new features of design, has been built recently by C. Bouillon, Torrington, Conn. It is equipped with a pattern plate to which wood and metal patterns may be attached easily and is so arranged that a stripping plate is unnecessary. It is said that the plates, with the patterns attached, can be changed from one job to another in two minutes, without necessitating any adjustments to the machine.

After the pattern is withdrawn from the sand, the mold rests free and loose on top of the frame, from which it may be removed by hand, or with a hoist. In the case of hollow patterns, the flask supporting frame and pattern plate can be blocked up to a suitable height, allowing an irregular parting line. The machines are intended to be used in pairs, one for the cope and the other for the drag.

The pattern plate is located by two dowels and is secured to a vibrating plate by four cap screws. The vibrating plate fits on and forms a cover to a box-shaped platform provided with a central plunger, side guides and a hand lever with a toggle motion to raise and lower the pattern; a balancing spring is enclosed within the hollow plunger. The guides attached to two opposite sides of the plunger casting are tubular in form and slide freely into bushings pressed into the frame of the machine; the center distance between the guides corresponds exactly to that of the flask ears and pins. The upper portion of the guides is bored out to fit the flask pins or to receive locating pins, as the case may be.

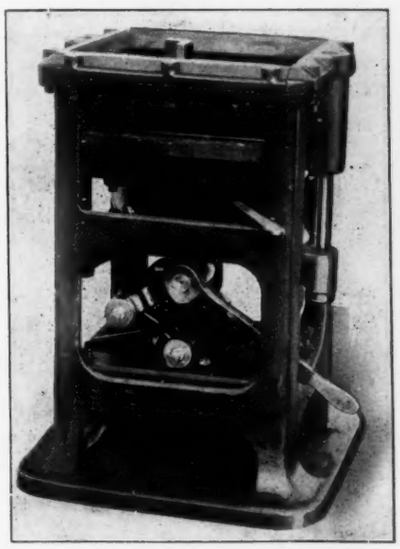


FIG. 1—VERTICAL DRAW MACHINE SHOWING RAPPING LEVER

The vibrating plate, during the process of ramming or drawing the pattern, is locked automatically to the platform; the vibrating is performed by the hand lever shown in front and to the right of the machine. This lever is moved from right to left and back, one or more times, unlocking the vibrating plate and moving it toward each corner successively a predetermined and fixed amount.

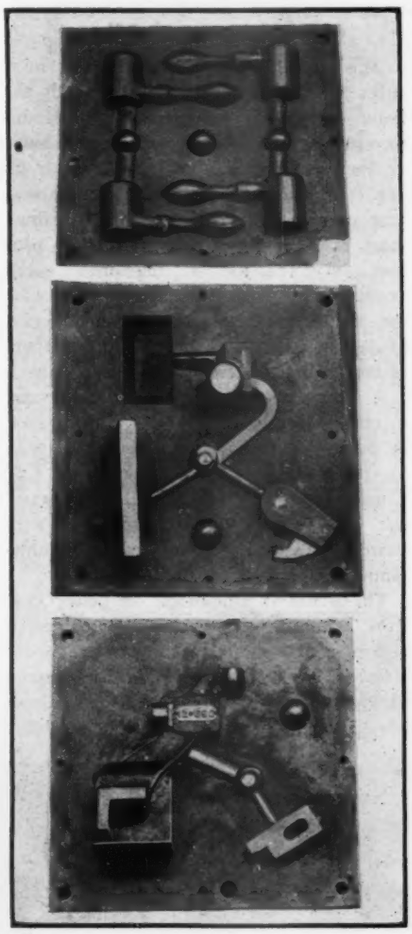


FIG. 2—PATTERN PLATES READY TO MOUNT ON MACHINE

In the center of the box-shaped platform, and cast with it, is a turned hub of large diameter. The upper part is flush with the top of the box and across the ends the hub has a carefully machined groove, rectangular in shape, 2 inches wide by 1½ inches deep; the underside of the vibrating plate has a similar groove but located at right angles to the one in the hub. Fitting closely to these grooves is a cross-shaped piece, each bar of the cross filling one groove in width and depth, but leaving end play, thereby allowing the plate to move only in the four directions determined by the sliding of the cross bars in the grooves.

On the circular hub is fitted a ring having four notches properly spaced around the periphery and fitted to these notches are blocks so shaped as to form lobes or rises making the ring a four-point cam. The blocks are radially adjusted by inserting back of them suitable packing strips of a selected thickness corresponding to the amount of rapping desired; diametrally opposite each block, the ring has a suitable depression. The circular portion of the cam ring, when the plate and pattern are in a normal position, is in close contact with four hardened and ground rollers carried on studs fixed to the undersurface of the vibrating plate. One roller

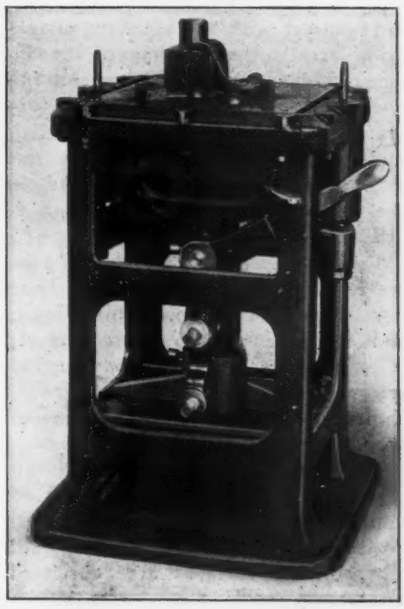


FIG. 3 — VERTICAL-DRAW MACHINE, SHOWING TOGGLE MECHANISM

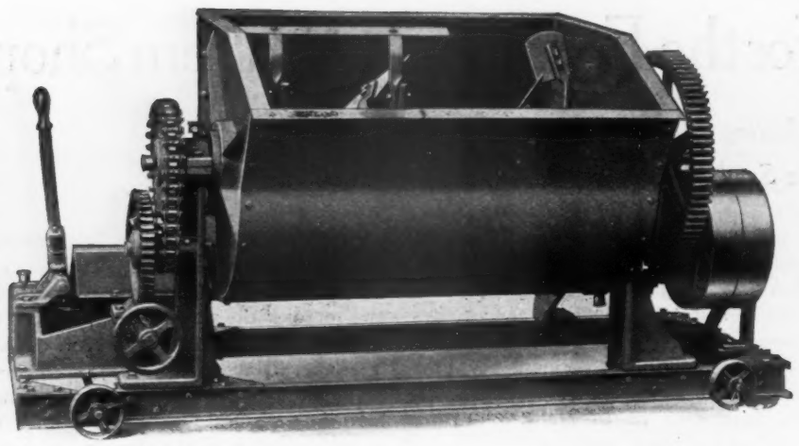


FIG. 1—IDEAL CORE SAND MIXER

is located opposite each end of the bars of the cross guide and together they lock the vibrating plate against each horizontal motion. If the ring is rotated approximately one-fifth of a turn, each one of the rises on the cam ring is brought successively in contact with a roller, the opposite roller entering the depression in the ring, and the plate is moved in four directions at right angles to each other during one trip from right to left of the lever; the vibrating is repeated upon returning the hand lever to its first position and the rollers being all in contact with the circular portion of the cam, the pattern then is in the center of the cavity thus formed in the sand and can be lowered without encountering the danger of dragging.

Ease of Operation

When the platform is lowered, the flask pins or ears are released from any contact with the machine, simplifying greatly the handling of the finished molds. With average conveniences and using solid flasks an operator, it is said, can finish a half mold and lay it on the floor in less than two minutes. This is based on the assumption that a 15 x 15 x 4-inch flask is used.

The machines at the present time are in use in the foundry of the Hendey Machine Co., Torrington, Conn., and are made to take pattern plates 15 x 15 inches or 15 inches long by any width under 15 inches. The machines have a maximum of 5 inches drop.

The platform containing the vibrating mechanism is closed tight and no sand can enter it; it is filled with grease and requires no attention. All other sliding surfaces are lubricated from compression grease cups, and it is claimed that no adjustments to the machine are necessary.

Ideal Core Sand Mixer

The economies of making core mixtures by machine as compared with the hand method are well known to foundrymen generally. The amount of binder required is reduced from 40 to 50 per cent, and, in addition, a better mixture of the sand and binder is obtained than can be effected by the hand process. By the use of machines, every grain of sand is coated uniformly with the binder, resulting in the production of better cores than can be made from mixtures merely cut-over with a shovel.

A heavy duty, power dump, core sand mixture, shown in Figs. 1 and 2, now is being offered to the foundry trade by the Ideal Concrete Machinery Co., Cincinnati. The machine is designed for maximum speed combined with thoroughness in mixing, with a minimum consumption of power.

The drum is supported on heavy cast iron trunnions operating in babbitted bearings, and mounted on massive pedestals. The shell of the drum is made of No. 8 gage steel plate, insuring long life under hard service. The paddles are designed to thoroughly clean the drum with the least amount of wear on the shell. A one-inch clearance is provided between the paddles and the shell of the drum, and the two scraper blades that clean the shell are set parallel in the shaft, each being slightly longer than one-half of the shaft, and are set opposite to each other. The blades are set at such an angle that they scrape the material away from the shell without grinding against it. By this arrangement the wear on the paddle blades as well as on the shell is reduced greatly.

The power dumping mechanism is driven directly from the main shaft through a train of gears, sprockets and chains, and the batch can be dumped from the mixer and the drum returned to loading position in 20 seconds. In Fig. 2 the drum is turned over to dump the batch of core sand. It will be noted that the mixer is mounted on a substantial structural steel base provided with four wheels to facilitate handling. If desired, the machine can be dismounted from this base for permanent location in the core room. The dimensions of the mixer follow: Height overall, 4 feet; length, 8 feet; width, 4 feet, 5 inches; width over skids, 3 feet; width of drum, 3 feet, 6 inches; length of drum, 4 feet, and capacity, 7 cubic feet of loose material, approximately 650 pounds of core sand.

Plain Talk About Selling Castings

By F. H. Scantlebury

Is your shop one of the many foundries running only part time and is the work you are doing resulting in a profit? Nowadays it seems to be the common practice among foundrymen to pound the superintendent to effect a reduction in the cost of manufacturing castings. How many foundry executives view the problem in

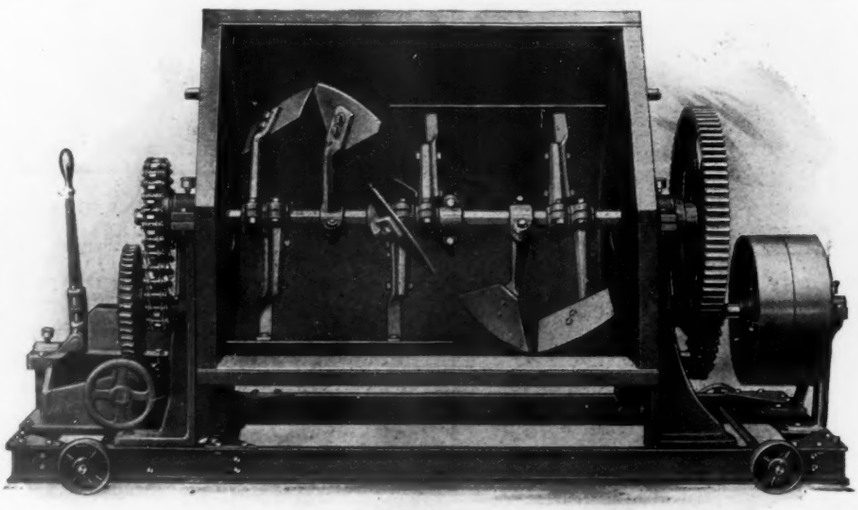


FIG. 2—CORE SAND MIXER IN DUMPING POSITION

another light and endeavor to increase the selling price of their product by improving its salability? In many foundries the selling prices of castings named are so low that there is a very slight margin between the actual cost of the metal, coke and other raw materials and the price paid by the purchaser. If losses are incurred in making the castings, this margin of profit is immediately absorbed and the castings are produced only at a loss. Why not strive for better work and improved castings? The fact that you may be pressed close to the cost line in selling your castings does not alter the fact that some one else is selling castings for much more money than you are getting per pound.

The purpose of this discussion is to direct attention to the desirability of two features of casting practice. First, make good castings, and second, give your castings the benefit of the best possible finishing or cleaning methods. The writer is connected with a firm, one branch of whose business it is to sell castings, the product being received from many different foundries. He comes in contact with a large number of casting producers every month and it might be well for the average foundryman to note the attitude of purchasers regarding sand-blasted castings and those that are ordinarily cleaned. Sand-blasted castings sell at a higher price than those cleaned in the ordinary way. On the other hand, the metal, coke, workmanship and overhead expenses are no greater for sand-blasted castings than for castings that are tumbled only or brush-cleaned.

One of the principle objections to the installation of a sand blast has been the difficulty of employing labor for this work, owing to the almost unendurable dust in the room in which the operator is compelled to work. However, today this dust is being removed and the operator no longer is subjected to this annoyance. Sand blast machines now are being built that require no special rooms or other equipment and are connected with an exhaust system which operates continuously and with a remarkably low power consumption. The operator's duties are confined entirely to loading and unloading the castings, while the machine does the rest. Cleaning castings by the method formerly in vogue is distinctly unprofitable, and as the castings bespeak the progressiveness of the foundry in which they are made, it is advisable to furnish the trade with castings that are well-cleaned by the sand blast process.

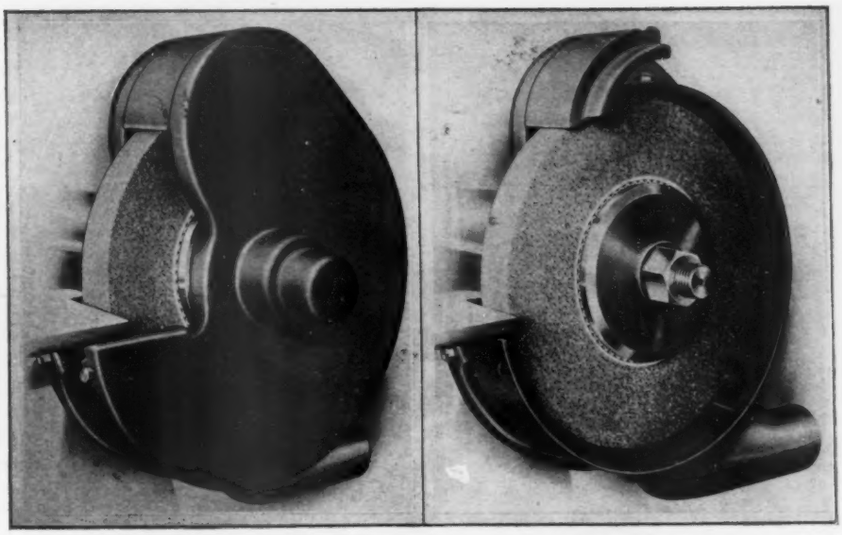


FIG. 2—ANOTHER TYPE OF PROTECTION AND DUST HOOD SHOWN IN CLOSED AND OPEN POSITION

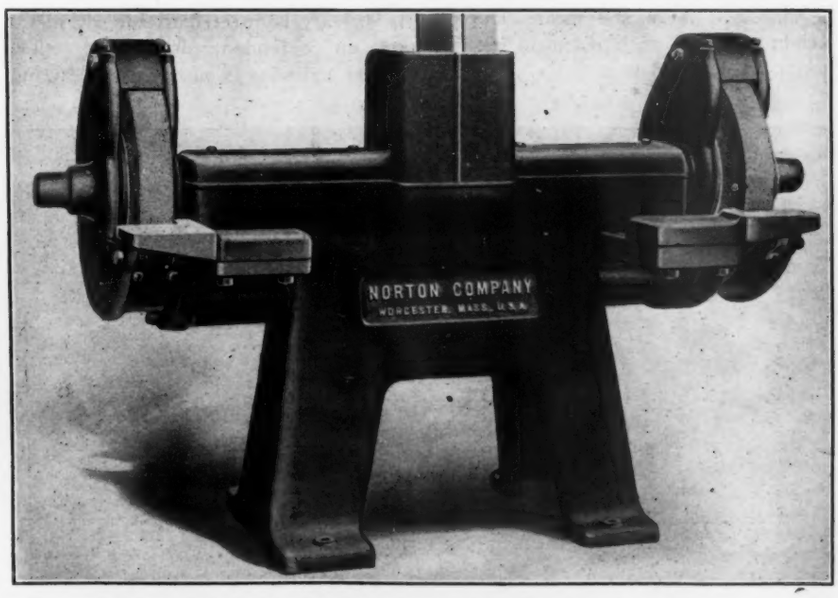
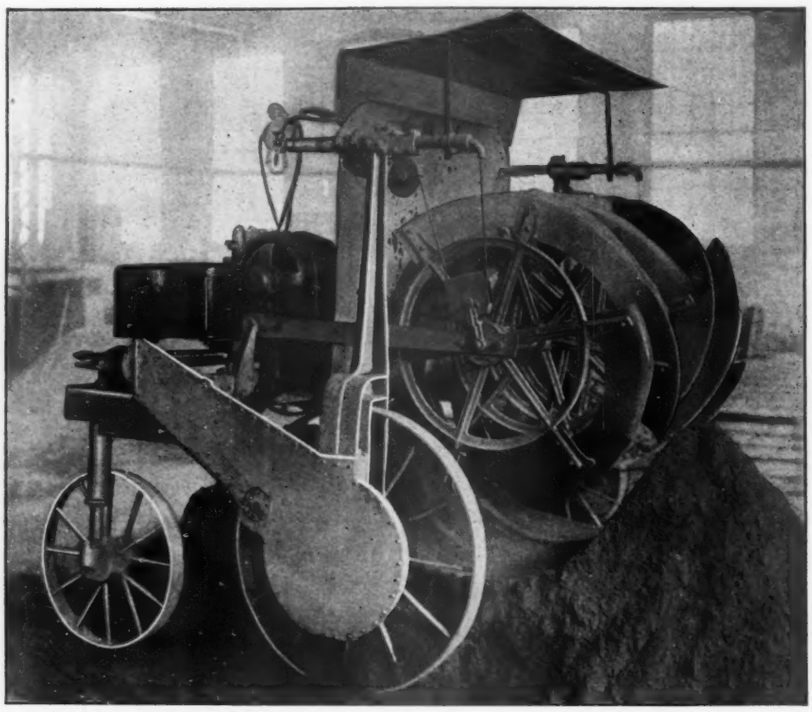


FIG. 1—NORTON GRINDING WHEEL STAND EQUIPPED WITH PROTECTION AND DUST HOODS

Protection Hoods For Grinding Wheels

A new type of grinding wheel stand built by the Norton Co., Worcester, Mass, is shown in Fig. 1. The design embodies the experience of this company in the use of grinding wheels on the many types of floor stands generally employed, and the designers have endeavored to incorporate into it every feature that will increase production and will give longer life to the grinding wheels and the machine itself. While the foundation space occupied by the machine is small, its weight and rigidity permit of a very desirable overhang of the bearing bed. This feature allows ample foot room for the operator. Each bearing is divided into two parts, and the large bearing surfaces help to insure long life. The diameter of the spindle in the bearings is made 1-16 inch oversize, allowing sufficient stock for regrinding when this becomes necessary. The portion of the spindle outside the bearings is made sufficiently long to take taper wheels ½ or ¾ inch taper per foot, which have the same width of face as the maximum width of straight wheels. End play on the spindle is easily taken up.

The inside flanges are fitted loose on the spindle and being driven by a key, their removal is easily accomplished. Taper flanges of any make may be used on these machines provided the whole is of the right size. This is accomplished by cutting a spline in the hole of the inside flange to fit the square key in the spindle. Oiling is accomplished by the splash system, insuring positive lubrication. The oil reservoir



IMPROVED AUTO SAND MIXER, SHOWING GUARDS COVERING GEARS AND OTHER PARTS

under and between the two parts of the bearing holds a supply of oil sufficient for several months' operation. Dust-proof covers protect the bearings and oil chambers, and an oil guard inside the bearing chamber prevents the oil thrown up by the splasher from working out through the joints of the bearing bed and bearing cover.

The under side of the overhanging bearing bed is provided with a machine seat and T-slots. Work rest brackets, protection hoods and surface grinding attachments are secured by bolts placed in these T-slots, and may be attached or removed quickly. Whenever it is desired to grind large work requiring the removal of the work rest, the work rest bracket also can be removed. This permits grinding large pieces without interference by projecting brackets, even if the wheel in use is of mimimum diameter.

In addition to the type of hood with which this machine is equipped, a new hood, shown closed and open in Fig. 2, is being built, which is adaptable to any make of floor stand conforming to the general contour of the Norton stand. In using this hood it is only necessary for the purchaser to provide a suitable bracket to which may be attached the inner head, which in turn holds the entire structure. This hood is designed so that it is adjustable about the wheel, permitting the grinding to be done on top, at the front or at the bottom of the wheel. Instead of the bracket, by means of which the hood is fastened to the wheel, serving also as a dust exhaust pipe, the inner head of the hood is solid and the exhaust pipe is located on the boiler-plate band. The exhaust pipe is mounted on a steel plate of the same radius as the band, and is firmly bolted to the latter.

These grinding wheels stands are manufactured with 1¼, 1½ 1¾ and 2-inch spindles, and a 2½-inch machine can be supplied on order. The 2-inch machine has a distance of 62 inches between wheels, an overall length of spindle of 79¾ inches, and the floor space occupied is 27 x 88¼ inches. The maximum size of the wheels that can be employed is 24 x 4 inches, and the weight of the machine, including the hoods, is 1,705 pounds.

Improved Sand Mixing Machine

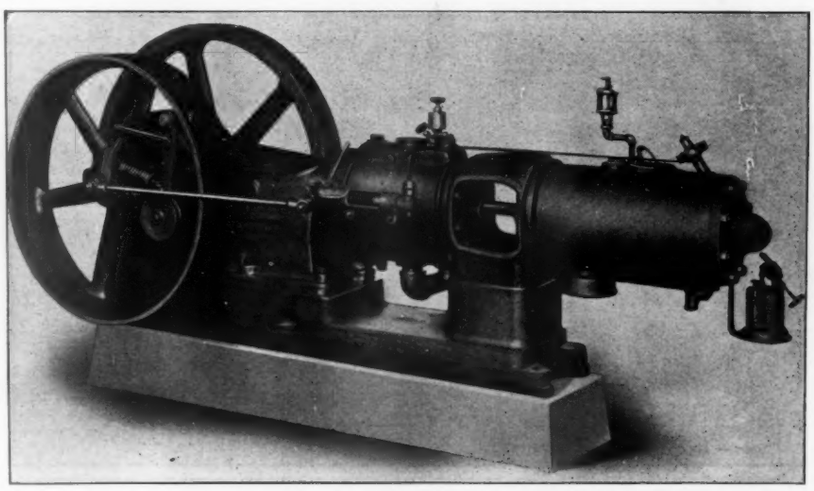
A sand mixing machine of an improved type, built by the Sand Mixing Machine Co., 220 Broadway, New York City, is shown in the accompanying illustration. The chief difference between this model and the machine placed on the market six years ago consists in the addition of safety guards to protect the workingman operating the machine. Means also have been provided for lifting by power the cutting cylinder which formerly was lifted by hand.

Among the companies that have replaced their old equipment with new machines is the Union Mfg. Co., New Britian, Conn. A mixer of the old type was installed in this plant three years and seven months ago, and during that period it cut the sand in 58,719 heaps. During that entire period the machine was not once out of commission for repairs.

Oil Engine-Driven Air Compressor

The increasing use of low grade oil fuel for power purposes has lead to the design of an oil engine-driven air compressor by the Ingersoll-Rand Co., New York City. As shown in the accompanying illustration, this machine is of the direct-connected, straight line type and in this respect resembles this company's standard line of small compressors. The main frame is designed for a splash system of lubrication, which is of the enclosed type and is provided with removable covers.

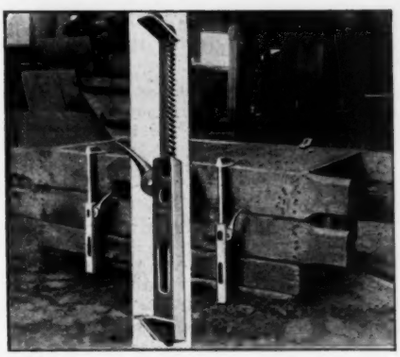
The driving end of this machine is the feature of greatest interest and consists of a single oil engine cylinder set behind the air cylinder and is directly connected to the air piston by an extended piston rod. The power cylinder is of the single-acting,



OIL ENGINE-DRIVEN AIR COMPRESSOR BUILT BY THE INGERSOLL-RAND CO.

two-cycle type. It is water-jacketed and is supported by a heavy distance piece reaching to the foundation and bolted to the air cylinder. Also, it is provided with a torch for heating the ignition bulb preliminary to starting. After the compressor is under way, this torch is dispensed with.

The fuel is injected automatically into the combustion chamber by a small pump on the side of the frame operated by the main shaft. The fuel enters in the form of a finely atomized spray and is ignited immediately by the hot bulb, dispensing entirely with electric sparking devices, batteries, etc. The stroke of the fuel pump is regulated by a centrifugal governor located in the flywheel, thereby regulating the amount of fuel injected into the cylinder in



CARLIN CLAMPS ON A FLASK

proportion to the loads. This is supplemented by a regulating device on the intake to the air cylinder, which is of standard design. The operation of this machine is not accompanied by losses resulting from the incoming charge following the exhaust gases through the outlet ports. This is due to the fact that the fuel is not vaporized by an outside agency and introduced with the air used for scavenging, but is injected directly into the cylinder at the end of the compression stroke. Consequently, the inlet and outlet ports can be so arranged that more thorough scavenging is afforded without loss of fuel. The absence of the usual carburetor is another advantage of this machine.

Another feature of this engine consists of the introduction of a small quantity of the water from the cylinder jacket into the combustion space. This water performs the function of regulating the temperature in the cylinder, thereby preventing undue rise in temperature of the piston, etc., causing dissociation of the fuel. The amount of water injected is regulated according to the load on the compressor. The machine, which is now built in only one size, has an actual capacity when running at 325 revolutions per minute of 66 cubic feet of free air at 100 pounds pressure and 73 cubic feet at 80 pounds pressure. The fuel consumption at this speed and under average operating conditions is about 2.2 gallons of kerosene per hour. The engine is adapted for operation on either kerosene, fuel oil or distillate, and its weight complete is 3,000 pounds.

Adjustable Flask Clamp

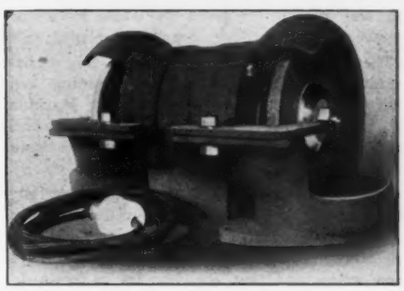
The accompanying illustration shows a metal adjustable flask clamp, which has recently been put on the market by the Carlin Clamp Co., 2142 Sheffield avenue, Chicago. The clamp is designed to do away with wedges, blocking and ordinary clamping irons, thereby saving the time of the molders. Three sizes are being manufactured. The first size has a range of from 6 to 10 inches, the second size from 10 to 19 inches and the third and largest size from 19 to 36 inches.

The clamp is specially designed so that it will not project very far from the sides of the flask. In construction it is somewhat similar to a lifting jack and is provided with an eccentric binding lever, which holds the extension arm of the clamp firmly in any desired position.

New Bench Grinder

Forbes & Myers, Worcester, Mass., have placed on the market a new line of bench grinders which can be used on ordinary lighting circuits. The motor is completely enclosed, as shown in the accompanying illustration, and the casing is so designed that it also forms a protection hood for the grinding wheels. The motor is rated 1/6-horsepower, but the current is small enough so that there is no danger of burning out fuses when the cord is attached to a lamp socket. The grinding wheels in the machine shown in the illustration are 6 inches in diameter with a ½-inch face.

These grinders also are built in



SMALL BENCH GRINDER

larger sizes for heavier work with ½ horsepower motors. This size motor is larger than should ordinarily be used on lamp sockets. A simple centrifugal device is used to open the circuit through the starting winding when the motor comes up to speed. The use of this device is desirable in order to obtain more power without making the diameter of the motor much in excess of the diameter of the grinding wheels. The ½ horsepower grinder is equipped with 6-inch wheels and has sufficient power for grinding lathe and planer tools, and other work of similar character.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Lebanon Foundry Co., Lebanon, Ind., has dissolved.

The Mulberry Foundry & Machine Co. is moving its plant to Kissimmee, Fla.

The Wausau Foundry & Machine Co., Wausau, Wis., contemplates reorganizing and enlarging its plant to make room for the manufacture of a patent feed mill.

The Barlow Foundry Co., Newark, N. J., has moved to 551 New Jersey Railroad avenue, near the South street station of the Pennsylvania railroad.

The Line City Foundry Co., South Beloit, Wis., has been incorporated with a capital stock of $8,000 by A. Balderson, George Bitzer and Daniel Broadhurst.

The American Car & Foundry Co., will reopen its plant at Binghamton, Tenn., recently damaged by fire. The principal loss was to the machine shop, power house, wood mill and blacksmith shop.

The Bennington Scale Co., Bennington, Vt., is moving into its new plant consisting of a foundry and machine shop.

Henry Seifert, Rock Elm, Wis., has purchased the foundry of J. S. Rounce, Ellsworth, Wis., and will take over the plant in the fall.

The plant of the Union Iron & Foundry

Co., Second, Barry and Kosciusko streets, St. Louis, has been sold to the P. Heibel & Sons Mfg. Co.

The Salem Foundry & Machine Works, Inc., Salem, Va., has reduced its capital from $30,000 to $15,000.

The New Standard Foundry Co., Detroit, has been incorporated with a capital of $50,000 by Bernard Stroh, Bernard Stroh Jr. and Edwin Stroh.

Fire May 6 damaged the plant of the Carroll Bros. Foundry Co., Houghton, Mich., to the extent of $250.000. The foundry will be rebuilt.

The Alloys Metal Foundry Co., Belleville, Mo., has been incorporated with a capital of $2,500 by William G. E. Rolar, Henry Rois, Hubert Hartman Jr. and Renst E. Wagelin.

The New Rochelle Foundry Co., New Rochelle, N. Y., recently incorporated with a capital of $15,000, will engage in the manufacture of gray iron castings. Frank J. Holler, 122 Fifth avenue, New Rochelle, is interested in the new company.

The Pneumatic Scale Co., Ltd., Quincy, Mass., has purchased, through the Factory Exchange, of Boston, the Nyhan Brass Foundry property at Quincy. The buildings on the site will be removed to make room for extensions to the Scale company's plant.

The Humphrey Pipe & Foundry Co., Bellefontaine, O., has purchased the building and land of the Bellefontaine Foundry & Machine Co. and will occupy the site soon. The firm will be in the market for a 5 to 10-ton hand power jib crane.

The Sterling Foundry Co., Ltd., Sterling, Ill., manufacturer of hardware and gray iron castings, whose plant recently was damaged by fire, advises that immediate repairs have been made, and that the foundry is again in full operation after an idleness of two weeks. The company is in position to furnish hardware specialties promptly and regular heats are being taken off daily.

The American Malleables Co., Lancaster, N. Y., has purchased the plant of the Alliance Motor Co., Owosso, Mich., owned by the General Motors Co. This plant will be enlarged and equipped for the manufacture of malleable iron. Particular attention will be devoted to the production of malleable sections for automobile parts. J. D. Cary will be superintendent of the new plant.

The machine shop, stock room and offices of the Ocala Iron Works, Ocala, Fla., were destroyed by fire on May 11 entailing a loss of $60,000. The machine shop of this plant will be rebuilt immediately and the company is anxious to obtain catalogs and prices on the following machine tools: 40 and 72-inch boring mill; 5-foot radial drill, 12, 18, 24 and 36-inch lathes, milling machine, shaper, planers, pipe machine, keyseating machine, bolt cutter, drill presses, emery wheels and a full line of small machine shop tools.

New Construction

The Freed Heater Co., Collegeville, Pa., is erecting a brick addition to its foundry.

The Farrell Foundry & Machine Co., Ansonia, Conn., will erect a new plant.

The Oxweld Acetylene Co., Newark, N. J., will erect a three-story addition to its plant at a cost of $50,000.

The McFarland Foundry & Machine Co., East Trenton, N. J., will erect a large addition to its plant.

The Standard Foundry Co., Anniston, Ala., will increase its capacity one-third by enlarging its plant.

Work has been started on the addition to the plant of the Cedar Falls Foundry Co., Cedar Falls, Ia.

Eynon, Evans & Co., Philadelphia, will build a $4,000 foundry at Fifteenth and Clearfield streets.

The Federal Steel Foundry Co., Chester, Pa., will rebuild its pattern shop which was damaged by fire.

Steel construction is going forward on the new plant of the Bessemer Foundry & Machine Co., Bessemer, Ala., recently burnt out.

The Malleable Iron Fittings Co., Branford, Conn., will erect a four-story and basement, brick, steel and concrete addition, 68 x 265 feet.

Cyrus Currier & Son, Newark, N. J., will build a new gray iron foundry, but no definite time has been set for the starting of this work.

The American Building Foundry Co., Chicago, has purchased a lot between Twenty-second street and the Burlington tracks on which it will build a one-story foundry and office building.

An addition, 64 x 75, of concrete brick and steel construction, will be erected to the molding shop of the Star Foundry Co., Covington, Ky. The molding room will be used for stove plate work.

The St. Louis Frog & Switch Co., St. Louis, has increased its capital from $200,000 to $350,000 and will erect a $25,000 foundry for the manufacture of manganese steel castings for special track work.

The Pacific Ornamental Iron Works, Los Angeles, will build a machine shop containing approximately 45,000 square feet of floor space. Machinery and appliances for turning out ornamental iron, brass and bronze work will be required.

A foundry is being built by the Cyclops Foundry Co., Monongahela, Pa., to replace the shop destroyed by fire. The new plant is electrically equipped throughout and is expected to be ready for operation by July 1. The offices of the company are in Pittsburgh.

A foundry is being built at 118 Yale avenue, Columbus, O., by Elder & Hendry. The chamber of commerce was instrumental in starting the plant in order to retain foundry work which was said to be leaving the city. The capacity of the foundry will be 10 tons of gray iron castings a day.

Manning, Maxwell & Moore, Inc., New York City, railway and machine tools and supplies, has let contracts for additions to the plant of the Putnam Machine Co., Fitchburg, Mass., including a main shop, two stories, 220 x 300 feet; a foundry, 120 x 200 feet; a blacksmith shop, 50 x 100 feet; a pattern shop, four stories, 50 x 100 feet, a power plant, two stories, 48 x 84 feet; and an office building, three stories, 50 x 100 feet.

Among the Brass Founders

The Clover Leaf railway will add a brass foundry to its shops at Frankfort, Ind.

The Poughkeepsie Brass Foundry Co., Poughkeepsie, N. Y., has filed notice of dissolution.

The Bunting Brass & Bronze Co., Toledo, O., has increased its capital stock from $50,000 to $100,000.

The Franklin Brass Foundry, Long Island City, N. Y., will erect a one story brick addition, 100 feet square.

A 900-foot, reinforced concrete addition to the brass and aluminum foundry of Dodge Bros., Detroit, is nearing completion.

A. Schiffer, 2235 East Eighty-fifth street, Cleveland, will erect a two-story addition to a brass foundry at 1366 East Forty-seventh street, to cost $3,500.

The Western Brass Co., Milwaukee, has been incorporated with $25,000 capital by Loe E. Kennedy, Harry W. Brown and Frank H. Hannaford.

The Franklin Brass Foundry Co., 102 Varick street, Brooklyn, N. Y., will erect a foundry, 100 x 100 feet.

The Plymouth Foundry & Machine Co., Plymouth, Wis., recently increased its capital stock from $30,000 to $65,000 to provide funds for the erection of a warehouse, 60 x 136 feet.

The Jackson Metal Products Co., Jackson, Mich., has acquired the plant formerly occupied by the State Foundry Co. and will engage in the manufacture of radiators and sheet metal stampings.

The Waynesboro Metal & Foundry Co., Waynesboro, Pa., manufacturer of brass and bronze castings, has increased its capital to $50,000 and is building a foundry, 60 x 130 feet.

The Northwest Aluminum & Brass Foundry, Inc., Rochester, N. Y., has been incorporated with $10,000 capital by John R. Laysen, George A. Hetzler and Charles E. Tupper.

The Lorain Brass & Bronze Foundry Co., Lorain, O., has been incorporated with $2,000 capital to engage in the manufacture of brass castings. E. M. Cable, W. N. Harding, J. Finegold, P. Finegold and A. J. Gabriel are the incorporators.

A syndicate connected with the A. B. Stove Co., Battle Creek, Mich., has taken over the Michigan Brass & Foundry Co., Detroit. The plant will be opened immediately. Louis Wurzer is president, John A. Alexander, director, and Frank Berry, secretary-treasurer.

The Aluminum Goods Mfg. Co., Newark, N. J., will build a one-story addition to its plant at Springfield and South Nineteenth streets, to be used as a foundry. The company has also purchased a site, 270 x 575 feet.

The Brass & Copper Products Co., Chicago, has been incorporated with $25,000 capital to operate a machine shop, rolling mill, planing mill and foundry. The incorporators are William R. Tribbey; Rae Landensohn, 5440 Winthrop avenue; George Hester, 1455 South Michigan avenue.

The Massillon Aluminum Co., Massillon, O., has been incorporated with $200,000 capital to engage in the manufacture of aluminum cooking utensils. The plant of the Reed Glass Co. has been purchased and this will be remodeled for foundry use. The incorporators are Frank H. Snyder, J. V. Miller, I. M. Taggart, Charles F. Snyder and Robert R. Hess.

The Southern Metal & Foundry Corporation of Norfolk and Portsmouth, Va., to be capitalized at $100,000, has purchased the plant of the Truckers Mfg. & Supply Co., Portsmouth. It will commence to refine brass foundry residue and manufacture engine and journal brasses about Aug. 1. The company is promoted by Fred D. Miller, Westminster, Md.

The Atlas Brass Foundry Co., Columbus, O., recently incorporated with a capital of $65,000, does not contemplate additions to its plant and is not in the market for equipment. It will continue to make brass, bronze and aluminum castings, screw machine products and bronze geared circulating pumps. The officers are John Wittman, president; Irving H. Pleukharp, vice president and treasurer; Edward D. Wittman, general manager, and F. J. Wittman, secretary.